

Abstract

Sojourner, Russell James. The Influence of Pictorials on the Comprehension and Retention of Pharmaceutical Information. (Under the direction of Michael S. Wogalter.)

Nonverbal symbols such as pictorials are increasingly being recommended and used to convey warnings and other safety-related information. The widespread proliferation of pictorials is based on the pervasive research finding involving the facilitative effects of pictures on text comprehension and memory. While fully redundant text and pictorial messages often facilitate performance, it is unknown what may result when textual instructions are accompanied by an incomplete set of pictorials, where each and every textual item is not supplemented by an accompanying pictorial. To evaluate the practice of communicating information using various pictorial/text formats, fictitious yet realistic-appearing medication instruction sheets were created that presented eight dosing instructions in the following formats: text alone, pictorials alone, fully redundant text and pictorials, text with four instructions accompanied by pictorials (incomplete pictorials), and no instructions (control). Following exposure to one of the instruction sheets, participants were given recall tests on the content of the medication information. Results demonstrated that instructions from the fully redundant text and pictorials format were recalled more often than instructions from the other formats. In addition, there were no differences in recall between the text alone and incomplete pictorials formats, with the pictorials alone and control formats producing the poorest recall. Also, the fully redundant text and pictorials format was given higher ratings than the other formats, with no differences between the text alone and incomplete pictorials formats. The pictorials alone and control formats received the lowest ratings. An age-related decline in recall was observed, with older adults recalling far less information

than undergraduates or younger adults. The advantages of using fully-redundant text and pictorials are discussed, as are the implications involved with accompanying text with incomplete sets of pictorials.

**The Influence of Pictorials on the Comprehension
and Retention of Pharmaceutical Information**

by

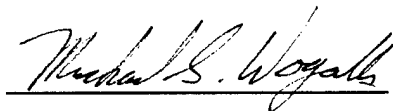
Russell James Sojourner

A dissertation submitted to the Graduate Faculty of North Carolina State University
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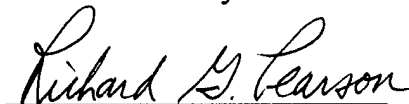
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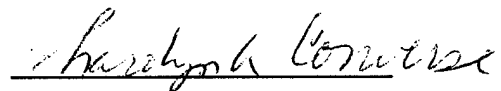
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Biography

I was born in Yuma, Arizona on 10 March, 1962. I attended public school in numerous states, graduating from high school in Colorado Springs, CO in 1980. While in Colorado I met my high school sweetheart, first true love, and eventual wife, Lori Dickinson.

I received a BS in Human Factors Engineering from the United States Air Force Academy in 1984. Upon graduation I was commissioned a second lieutenant in the Air Force, and became a Program Manager at Space Division, Los Angeles AFB, CA. After 3 years in sunny California I transferred to Raleigh, where I began my graduate school career at NC State, eventually receiving an MS in Industrial Engineering in 1989. Upon graduation I was transferred to HQ Air Force Space Command at Peterson AFB, CO, where I managed the Military Man in Space Program. After three years in the space business, I transferred to the faculty at the United States Air Force Academy (USAFA), where I became an Assistant Professor in the Department of Behavioral Sciences and Leadership. After three years at USAFA, I discovered that teaching was the gift given to me by God, and I convinced myself to return to academia as a student. I left USAFA in 1994, returning to NC State to work on my Ph.D.

Upon graduation from State I will be returning to Air Force Space Command. Following my tour there I will transfer back to the Air Force Academy, where I'll serve as an Associate Professor until retirement from the Air Force, at which time I hope to continue in some capacity the process of broadening young peoples' minds.

Acknowledgments

I first want to thank God for His presence in my life. Through His wisdom and grace, I've come to realize the meaning of unconditional love. "What can we ever say to such wonderful things as these? If God is on our side, who can ever be against us?" (Romans 8:31-32).

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I would also like to sincerely thank the chair of my committee, Dr. Michael Wogalter, for his enthusiasm and insight into the warnings arena. Dr. Wogalter has given me a true appreciation for the fascinating and exasperating world of research and publishing.

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To my wife and best friend, I owe gratitude that can never be expressed or repaid. Her love for me and confidence in my ability gives me strength each and every day. I can't imagine enduring this journey without Lori walking by my side.

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Introduction

Prior to the mid 1980s, there was virtually no published experimental research on product warnings. Since then, research has begun to investigate how warnings influence people's knowledge and cautionary behavior. A multitude of factors have been investigated, with an emphasis on warnings' influence during human information processing.

Warnings' Influence on Human Information Processing

Many of the processes associated with warning effectiveness can be organized using one of several models of human information processing (see Wogalter & Sojourner, in press). This modeling approach categorizes people's mental activities into a coherent sequence of processing stages. The influence of warnings on the stages of attention, comprehension, memory, and attitude formation have received particular interest.

To study influences on attention, Barlow and Wogalter (1991a) developed expanded surface area labels which increased the available size and space for information printed on very small product containers. Participants were shown different label designs, and results indicated that larger print (expanded surface area) labels were perceived to be more noticeable by both undergraduates and elderly participants. Wogalter, Forbes, and Barlow (1993) performed additional research by manipulating the size of printed warnings on expanded surface area labels. Once again, undergraduates and elderly participants perceived the larger print labels to be superior in terms of attention-getting characteristics. Wogalter and Young (1994) extended the expanded surface area studies by investigating behavioral compliance to the labels. In

this study, participants used a small glue bottle with smaller or larger print labels to perform a model airplane assembly task. The compliance measure was whether or not participants wore protective gloves when using the glue. Results demonstrated that participants wore the gloves significantly more often when the label included larger print warnings.

Much of the previously-cited research concerning attention is also applicable to the area of comprehension. For instance, the Barlow and Wogalter (1991a) and Wogalter and Young (1994) studies both showed that larger print warnings were rated easier to read (a measure presumably reflective of comprehension) than other warnings designs. Warnings comprehension has similarly been studied by numerous researchers in a variety of settings (see Edworthy & Austin, 1996).

Concerning memory, Young and Wogalter (1990) assessed recall for information contained in various warning statements. In this study, participants examined for a limited period of time an instruction manual containing various warnings which differed in degree of salience (i.e., conspicuous print, color highlighting, and related icons). Results showed that participants who read the highly salient warnings recalled the message content better than the participants who received other warnings formats.

In the area of attitude formation, Wogalter and Barlow (1990) examined how different warnings affect hazard perception. Participants rated the level of hazard associated with product warnings which communicated varying levels of injury severity and likelihood. Results showed that (1) the presence of a warning increased the products' perceived level of hazard, (2) products with high severity warnings were viewed to be more hazardous than products with low severity warnings, and (3) the

likelihood of injury in the warnings had no influence on hazard perceptions. Hazard perception was also studied by Wogalter and Silver (1990), who had participants rate potential signal words on various dimensions. Results demonstrated that of the three most commonly recommended (by various warnings standards and guidelines) signal words, DANGER was given greater strength and arousal judgments than WARNING and CAUTION, and there was no perceived difference between WARNING and CAUTION. Similarly, Wogalter, Godfrey, Fontenelle, Desaulniers, Rothstein, and Laughery (1987) also investigated hazard perception, and found that warnings with greatest perceived effectiveness generally require a signal word plus hazard, consequences, and instruction statements.

Warnings Categories

Research into the influence of warnings on information processing has involved a variety of warning categories in a multitude of settings. The most frequently studied warnings are those which exist on common household consumer products. Barlow and Wogalter (1991b) investigated warnings on alcoholic beverage labels in print advertisements. In this study, participants paged through a simulated magazine which included numerous alcohol advertisements that included various text warnings differing in conspicuity and shape. Participants were later given an unexpected memory test on the content, location, and configuration of the warnings. Results showed that the warnings did communicate information about the hazards of alcohol consumption. Furthermore, highly conspicuous (larger, higher contrast) warnings were remembered better than less conspicuous warnings. A common consumer product was also used by Frantz (1993, 1994), who studied warnings on a household water-repellent sealer. In

these studies, the placement and explicitness of precautionary warnings on a water sealer container were manipulated. Participants used the water sealer in a common household repair task which required them to read the container label to assure proper handling of the sealer. Frantz found that integrating explicit warnings into the textual instructions (as opposed to separating the warning information) on the label increased the number of participants who read and complied with the prescribed sealer warnings. Strawbridge (1986) used another common household product when researching the issue of integrating warning information into textual instructions. Using instructions and warnings on a glue bottle label, Strawbridge found that embedding the warnings information into the instructions increased the number of participants that read the warning information. However, contrary to the Frantz (1993, 1994) studies, Strawbridge found that integrating instructions and warnings actually decreased compliance behavior to the warnings information.

While warnings on household consumer products tend to receive the most research attention, other environments and products have also been investigated. Brelsford, Wogalter, and Scoggins (1994) tested comprehension for industrial safety pictorial warnings found in industry (FMC, 1985; Westinghouse, 1981). Brelsford and his colleagues trained participants on the meaning of industrial pictorials, and later tested their comprehension at multiple intervals post-training. Results showed that brief training, as little as giving a pictorial's verbal meaning once, had a large impact in facilitating comprehension for pictorials that otherwise were not understood by many people. Johnson (1992) also used a warning commonly found in an industrial environment. In this study, a warning label was developed for scaffold workers which

identified the potential dangers of working on scaffolds. The warning was developed and tested on both experienced and inexperienced scaffold workers. Results showed that the warning increased participants' intentions to seek out safety information before working on a scaffold never encountered before. Still other research has investigated warnings in settings ranging from elevators (Wogalter, Allison, & McKenna, 1989) to swimming pools (Boersma & Zwaga, 1989; Loring & Wicklund, 1988) to computers (Cox, 1995; Horton, 1994).

Warnings Design

Regardless of the warning category or environment, a pervasive research finding is that warning effectiveness depends largely on proper design of the warning itself. Correspondingly, a wide variety of warning features have been investigated. Laughery and Stanush (1989) manipulated warning "explicitness"; that is, how specifically potential injury consequences were described. Participants were first exposed to multiple household product warnings that described injury consequences using low or high explicitness, and then completed a questionnaire covering various aspects of warning perception (i.e., product familiarity, perceived dangerousness, willingness to purchase, etc.). Results suggested that products are perceived as more dangerous, and related injuries are perceived as more severe, when warnings are explicit. Wogalter and Silver (1995) examined a related concept by assessing the effectiveness of potential signal words at conveying different levels of hazard. In this study, a large and diverse participant group (fourth to eighth-grade students, undergraduates, elders, and non-native English speakers) rated a list of potential signal words on how careful they would be after seeing each term. Results showed that in general, the rank ordering of the

words was found to be consistent across participant groups. Furthermore, DANGER consistently had higher carefulness ratings than did WARNING and CAUTION, a result consistent with other signal word studies (Bresnahan & Byrk, 1975; Dunlap, Granda, & Kustas, 1986). Desaulniers (1987) also investigated warning design by performing a series of studies examining the effects of warning layout and organization on the readability and retention of warning information. Results demonstrated that warnings in an outline format were rated as having greater eye appeal, easier to process, and more effective than other, more traditional (paragraph) formats. Furthermore, while participants took longer to read the outline warnings, they were read and complied with by a larger proportion of participants than warnings in a paragraph layout. Young (1991) manipulated the appearance of warning information by investigating the effects of pictorials, color, signal icons, and border. Participants viewed simulated alcohol labels on a computer that either did or did not contain a warning. Upon exposure to the label, participants indicated as quickly as possible whether or not a warning was on the label. Results indicated that warnings containing a pictorial, color, and icon had significantly faster response times than warnings without them. Inclusion of a border surrounding the labeled information had no effect on response times. As Young demonstrated, the use of pictorials appears to be one method which facilitates the communication of warning information.

Pictorial Warnings

Pictorials can be defined as any non-verbal graphical symbol or image that conveys ideas or information (Lodding, 1983). Foster (1994) lists the following criteria which should be satisfied by a well-designed pictorial: (1) Detectability - the pictorial should be

detected; (2) Discriminability - the pictorial should be discriminated from other pictorials; (3) Conspicuity - the pictorial should gain attention; (4) Visibility - the pictorial should be recognized when presented under poor viewing conditions; (5) Comprehensibility - the pictorial should communicate the intended meaning; and (6) Behavioral effect - the pictorial should appropriately affect behavior.

Well-designed pictorials are increasingly being recommended and used to convey warnings, risk communication, and safety-related information. Laux, Mayer, and Thompson (1989) state that many books and standards on the design and development of warning labels recommend the use of pictorial information whenever possible. Young and Wogalter (1990) cite the fact that pictorials are often mentioned as an important component of effective warning design. Accordingly, most warnings guidelines and standards (e.g., ANSI, 1991; FMC, 1985; Westinghouse, 1981) recommend the use of graphical symbols. Consequently, pictorials have been designed to depict various kinds of hazard-related information in industrial settings, by health care providers, and on consumer products.

The increasingly widespread use of pictorials is based on the assumed beneficial nature of depicting information in picture form. Research suggests that pictorials can be useful in conveying information. For example, Childers, Heckler, and Houston (1986) studied consumer product advertisements which contained both pictured and textual information. Two days after reading the advertisements, participants were administered recall and recognition tests, and results showed that pictured information was remembered better than textual information. Jaynes and Boles (1990) examined behavioral compliance to textual and pictorial warnings. In this study, participants

performed a chemistry-type experiment using a set of instructions that contained varying combinations of textual and pictorial warnings. Behavioral compliance was operationally defined as adherence to a warning advising the participants to use gloves and a surgical mask when mixing the chemicals. Jaynes and Boles found highest rates of warning compliance when textual information was combined with pictorials. Young and Wogalter (1990) performed research using instruction manuals for a gas powered generator and a natural-gas oven. The instruction manuals depicted warning messages using combinations of plain print, salient print, and pictorial icons. Participants were given an instruction manual and were told they would have to know how to operate the equipment from memory later in the session. After studying the manual, participants were given various tests of recall and recognition for the warning information contained in the manual. Results indicated that warnings which included both salient print and pictorial icons increased comprehension and recall. Morrell, Park, and Poon (1990) used a drug bottle label to present medication instructions in either a traditional text format, or in a format which combined text and pictorials. After studying a medication bottle label which presented information in one of the text/pictorial combinations, participants were asked to recall the instructions presented on the bottle label. Results showed that for young adults, the mixed text and pictorials instructions were comprehended and remembered better than the plain text instructions.

The stated benefits of using pictorials to convey information arise from the unique presentation method afforded symbolic information. Edworthy and Austin (1996) list the following as support for using pictorials to communicate information:

- (1) Symbols can be recognized by those who do not read printed verbal messages.

The most obvious reason for using universally recognized pictorials relates to increased international travel and communication which is facilitated if basic concepts can be depicted in a manner understandable to those from different language backgrounds. Also included in this category is the need to communicate to those who may be illiterate or at a lower developmental level (i.e., children) in any language.

(2) For messages of the same size, pictorials can be recognized from a greater distance, and with greater discriminability, than equivalent printed messages. Edworthy and Austin cite one study which showed that symbolic signs are recognized at twice the distance that is required to recognize the equivalent verbal sign. This advantage becomes especially critical for the elderly and those with vision problems who are hampered by degraded sight.

(3) Pictorials can be recognized more quickly and accurately than printed text. In one of the earliest pieces of research on symbol signs, Edworthy and Austin discuss research cited in 1934 by Jander and Volk which compared reaction times to both symbol signs and word signs that had a directional component. Participants had to push a lever in the direction indicated by the sign, and results showed that reaction times were shortest to the symbol version. The ability of well-designed pictorials to communicate concepts and instructions quickly and accurately has been a pervasive research finding for decades (e.g., Ells & Dewar, 1979; King, 1971; Walker, Nicolay & Stearns, 1965).

(4) Pictorial messages withstand degradation and interference. In terms of both visual degradation (e.g., viewing in suboptimal conditions such as low light, haze, and glare) and conditions of interference (e.g., time delays between viewing the pictorial and recall of the information, noisy environment, etc.), pictorials result in fewer response

errors compared to printed text.

(5) Humans possess a superior ability to recognize and recall pictured information. Wingfield and Byrnes (1981) cite a classic series of studies performed by Nickerson, who found that subjects were able to correctly recognize 190 of 200 photographs presented at random. The high rate of recognition was particularly noteworthy when compared to the usual decay associated with printed text.

(6) Pictorials are compact. A message which needs a number of words can be expressed by a single pictorial (Foster, 1994).

(7) Pictorials allow multidimensional representation. Pictorials can be depicted in a multidimensional format, incorporating such features as color, shape and size, as well as combinations of these into the basic pictorial (Dewar, 1994).

Although several studies noted above cite the benefits of using pictorials, empirical evidence has not always supported these claims. For example, Friedmann (1988) investigated pictorial symbols and written warnings on hazardous chemical labels. Using warnings associated with a simulated drain opener and wood cleaner, participants were told to use the simulated chemical in the manner prescribed by the instructions on the product label. Friedmann found that warning labels which contained pictorials had no effect on whether or not participants used the chemicals in a safely-prescribed manner (by donning goggles and a respirator). Similarly, Otsubo (1988) showed that the presence versus absence of pictorials on warnings for a circular saw and jigsaw had no effect on compliance behavior (putting on safety gloves). In a related compliance study, Wogalter, Kalsher, and Racicot (1993) used the simulated chemistry task paradigm to investigate various aspects of warning design, including voice generated

warnings, location of warning information, and warning format. One variable manipulated was the presence or absence of pictorial icons to present the hazardous chemical warnings, and Wogalter and his colleagues found no positive effect of pictorials on compliance. Using medication bottle labels, Morrell et al. (1990) found that for older adults, pictorials actually hindered the acquisition of safety information. In the Morrell study, participants were presented with drug bottle labels that depicted warning information in either a pictorial or mixed (text and pictorial) format. Using subsequent tests of comprehension and recall, Morrell found that older adults performed poorly when remembering the instructions depicted by the pictorials. Morrell et al. (1990) concluded that participants cognitively translated the pictorials into useful verbal instructions, introducing a processing burden on older participants which lowered performance relative to younger participants.

One reason that pictorials have not always been beneficial is that many are not well designed, and thus fail to convey adequately their intended message. To ensure a pictorial is adequately designed, Foster's (1994) criteria of detectability, conspicuity, discriminability, visibility, comprehensibility, and behavioral effect must be satisfied. Several studies have shown that many pictorials in use today are not widely understood, and thus fail to meet the criteria necessary for effective communication. For example, Laux et al. (1989) tested the comprehensibility of 16 common industrial pictorials found in the Westinghouse Product Safety Label Handbook (1981). Many of the pictorials were correctly interpreted by less than 50% of the people tested, and two of the pictorials were correctly identified by only one person. Wolff and Wogalter (1993) performed similar testing using 30 pharmaceutical pictorials published by the U.S. Pharmacopoeial

Convention (USPC), and found that several pictorials failed to meet the ANSI (1991) criteria of 85% comprehensibility. Other researchers (e.g., Collins, Lerner, & Pierman, 1982; Magurno, Kohake, Wogalter, & Wolff, 1994; Ringseis & Caird, 1995) have similarly demonstrated that many safety pictorials in use today are comprehended at low rates, and thus fail to convey their intended message.

In general, it appears that misinterpreted pictorials tend to represent abstract ideas (e.g., the passage of time), while better understood pictorials represent more concrete or visualizable concepts (e.g., no smoking). However, if pictorials are designed well and the concepts to be represented are not overly abstract or complex, the research suggests that pictorials can supplement textual information as an aid to comprehension and recall (Dewar, 1994; Morris & Halperin, 1979; Morrow, Leirer, & Sheikh, 1988; Wogalter, Rashid, Clarke, & Kalsher, 1991).

Information Processing Theories

As discussed above, a pervasive finding in the literature involves the facilitative effects of pictures on text comprehension and memory. Levin and Lesgold (1978) summarized nearly 20 experiments on picture-text learning, and describe the effects of supplementing text with pictures as being "positive, potent, and pervasive." Levin (1981) has suggested the following as positive functions that are served by combining pictures and text: (1) Motivation - pictures may have a motivating effect, serving to increase interest in the text, thereby increasing the likelihood that the text will be read carefully; (2) Reiteration - pictures may repeat the information presented in the text, providing additional exposure (redundancy) to the textual concept. Levin describes this as the "two exposures are better than one" concept; (3) Organization - pictures may help

to organize the content of the text into meaningful groupings; (4) Interpretation - pictures may serve to make relatively abstract or difficult concepts more understandable; (5) Transformation - pictures appear in a form which facilitates long-term memory; and (6) Representation - pictures make the material more specific, and provide a spatial format through which the semantic textual information can be cognitively represented. The functions involving Transformation and Representation are best summarized in terms of Paivio's Dual Code Theory.

Dual Code Theory

According to Dual Code Theory, text and pictures result in two different kinds of conceptual representations (or codes). Paivio (1975) believes humans possess a verbal system specialized for processing and storing linguistic (textual) information and a separate nonverbal system which processes spatial and mental imagery (pictures). The two systems can function independently, but are also interconnected. Independence implies that the two systems can be independently accessed by relevant stimuli. In other words, the imagery system is activated more directly by perceptual objects or pictures, while the verbal system is activated more readily by words or linguistic stimuli. Interconnectedness implies that stored nonverbal information can be transformed into verbal information, or vice versa. To illustrate independence and interconnectedness, consider a person looking at a picture of a dog with the text label "d-o-g" printed above the picture. According to Paivio (1975), the image of the dog is stored in the person's nonverbal (spatial) information processing system, while the word "d-o-g" is stored in the person's verbal (linguistic) processing system. This example illustrates independence of the two processing systems. Now consider the case where the person

looks only at a picture of a dog which is unaccompanied by a text label.

Interconnectedness of the two processing systems implies that the image of the dog will most readily be stored in the nonverbal processing system, but that the image may also be mentally transformed and subsequently stored as the word "d-o-g" in the linguistic processing system. Although the concept of interconnectedness allows transformation in either direction, Paivio admits that non-verbal (pictured) codes transform into verbal (linguistic) codes more easily than do verbal to non-verbal codes.

The superior dual-coding efficiency of pictured information may partly explain the pervasive finding that pictures are easier to remember than words. For example, Haber (1980, pg. 104) states the following:

"The capacity of memory for pictures may be unlimited. Common experience suggests that this is so. For example, almost everyone has had the experience of recognizing a face he saw only briefly years before. It is also significant that the name associated with the face is usually much harder to recall."

To confirm this assumption, Haber (1980) conducted a series of experiments where participants were presented with photographic slides of pictures and associated word labels. When participants were later asked which images (pictures or words) they had seen before, picture recognition was nearly perfect, while recognition for the word labels was significantly lower. Paivio, Rogers, and Smythe (1968) conducted similar research on picture-word memory. Using pictures and their associated verbal labels, participants first viewed a series of slides depicting picture-word combinations, and then completed a test of free recall for the presented information. Results demonstrated far superior recall of the pictures compared to their written verbal labels. Paivio et al.

(1968, pg. 138) concluded that "pictures are less susceptible than words to interserial interference or, more generally, pictures are more effectively stored in or retrieved from both long-term and short-term memory." The finding that pictures are easier to remember than their associated verbal labels has been labeled the "pictorial superiority effect," with empirical support dating back to the late 1800s (Nelson, 1979).

The pictorial superiority effect may be accounted for in terms of the relative distinctiveness of the visual features found in pictures and words (Nelson, Reed, & Walling, 1976). This assumption is consistent with Paivio's (1975) Dual Code Theory. Consequently, representing information in both a pictured and textual format assures that two visually distinct types of information will be encoded and stored in two separate information processing systems. Therefore, the stored information may be activated by either nonverbal or verbal stimuli, thereby increasing the probability of successful recall. To use a simplified illustration, if we consider the brain to be a large filing cabinet, the probability of locating and recalling a filed list of office employees increases if the list is filed in two different cabinet drawers. Chances for successful recall of the employees' identities increase even more if the list stored in one drawer consists of names on a page, while the list stored in the second drawer consists of pictures of the employees. In other words, the two processing systems are most easily accessed by storing related and relevant information which is depicted by text and pictorial codes representing the same concept. Consequently, in a dual-coded format, information gleaned from text may activate (augment) information gleaned from a pictorial, and vice versa.

In support of Dual Code Theory, Paivio (1975) conducted a series of experiments using pictures or words which depicted familiar objects. Pairs of stimuli shown to

participants differed along various dimensions, including apparent size, distance from the observer, or in pronunciation difficulty. Paivio found performance involving size or distance judgments (spatial or non-verbal tasks) was facilitated by pictorial representations, while performance on pronunciation tasks (utilizing verbal information) was aided by textual representations. These findings, along with other similar results (e.g., D'Agostino, O'Neill, & Paivio, 1977; Paivio et al., 1968), lend support to the notion that verbal and nonverbal information are processed in functionally different long-term memory systems.

Although Dual Code Theory is widely accepted as one explanation for the benefits of presenting information in both text and pictorial formats, other related theories exist. Three additional theories will be described here, and include Redundant Coding, Elaboration, and Mental Models.

Redundant Coding

Related to Dual Code Theory is Wickens' (1992) concept that presenting the same information in both textual and pictorial formats provides a means of redundant coding, where different formats emphasize different properties of the information. Depending on the task at hand, either the spatial information depicted in pictorials, or the semantic relationships found in verbal information, may be more relevant. In addition, communicating via pictorial/text combinations facilitates information processing by promoting flexibility, thereby enabling people to capitalize on the information extraction method (spatial pictures or semantic language) they process best. Wickens further believes that pictorials provide an overall context or "frame" within which words can be used to fill in critical details of the pictured concept. Overall, this redundancy results in

the most efficient processing of information, with redundant picture/word combinations resulting in superior response speed, accuracy, and recall, than either words or pictures alone (Wickens, 1992).

The superior performance attributed to redundant coding has been demonstrated by numerous researchers. Schmidt and Kysor (1987) assessed the comprehension of airline passenger safety cards presented in various combinations of text or diagram formats. After viewing the cards, participants were asked to explain their meanings. Results showed that the cards using mostly words were least well understood, while those employing diagrams were better, and the format which integrated both words and diagrams resulted in superior performance. Wickens (1992) discusses a study which compared participants' performance in assembling a model using pictorial instruction, text, or a completely redundant presentation of both. As expected, highest performance was found in the redundant condition. Similarly, Booher (1975) had participants read instructions which explained the proper use of an electronic component. Booher distinguished between redundant codes - where one code was emphasized and the other provided supplementary information, and related codes - where the non-emphasized code provided related (yet not redundant) information to the emphasized code. The instructions contained six different print-pictorial combinations. Booher found superior performance using pictorial emphasized-redundant print, and the worst performance using printed-only instructions. In all conditions, the use of pictorials aided in textual comprehension.

Elaboration

Wiseman, MacLeod, and Lootsteen (1985) propose a different theory to explain

why the combination of pictures and words results in superior recall. Using the Elaboration Hypothesis, Wiseman states that memory for a concept is improved when pictures are combined with words because there is more detailed synthesis of the information contained in the picture when a verbal description is added. In other words, the written label which accompanies a picture often provides additional detail about the meaning of the word/picture concept, resulting in more extensive processing that enriches the original pictorial presentation. In support of this hypothesis, Wiseman and his colleagues conducted a series of three experiments where participants studied photographs presented alone or followed by a descriptive sentence which provided additional information not available in the photographs. Subsequent recognition tests for the pictures demonstrated better memory for those pictures accompanied by descriptive sentences. Wiseman concluded that the verbal information presented subsequent to the pictures induced participants to review the representation of the pictures. Consequently, the sentences acted as a cue to process the pictures further, thereby bringing about additional elaboration.

Mental Models

Glenberg and Langston (1992) believe that pictures help people remember and comprehend text because pictures facilitate the construction of mental models. A mental model can simply be thought of as a representation of what the text is about. Glenberg and Langston propose that a mental model derived from text has the following characteristics: (1) it is a representation of what the text is about; (2) it is a representation that makes use of working memory, particularly the visuo-spatial scratchpad; (3) it consists of elements representing objects and ideas derived from the text; and (4) it

reflects a person's current understanding of the text, updated via additional processing as the text progresses. A critical assumption is that mental models are representations of situations described by the text, rather than representations of the text itself. Since pictures are also typical representations of situations, Glenberg and Langston assert that pictures assist in the construction of mental models because a picture's structure (relationships between parts) is often identical to the structure required by a mental model. Furthermore, pictures also ensure that fairly consistent mental models are shared by different people confronted by the same situation. Finally, stimulating the construction of mental models through pictorial representations aid the noticing of relationships implicit in the text, thus assisting in the creation of representations that are richer than would ordinarily be available from text alone.

To support their claims, Glenberg and Langston (1992) conducted two experiments where participants read a textual description of a four-step procedure that was either presented alone, or accompanied by redundant pictorials. An assessment was then performed on each participant which assessed their knowledge of strengths implied by various relationships represented in the text. Glenberg and Langston showed that when the text was accompanied by appropriate pictures, participants tended to mentally represent the entire procedure. However, when the text was presented alone, participants tended to mentally represent only the words making up the text. In other words, pictures aided in formation of a spatial schematic of the procedure, while the text without pictures was mentally represented by simple generalizations of the words making up the individual procedures.

Summary

Although various researchers propose different theories to explain the facilitative effect of using text and pictures to describe a concept, Wickens (1992, pg. 193) summarizes the common theme:

"Redundancy of information is of clear benefit to human performance. Because it captures the strength of different people, because it captures the essence of different kinds of material, because it is less sensitive to fluctuations in attention allocation, or simply because it produces a more firmly anchored and better retrievable knowledge base in long-term memory is not always clear. Probably all four factors work to varying degrees. But the picture stands as one of the more firmly validated in the engineering psychology of instructions."

Pharmaceutical Warnings

One practical application of using pictorials to augment textual instructions can be found when depicting safety and warning information on pharmaceutical products. The broad area of pharmaceutical warnings has received recent attention. For instance, Wogalter and Dietrich (1995) investigated the attention-getting properties of pharmaceutical labels. Over-the-counter (OTC) easy-open cap containers (with enlarged caps which substantially increased the usable surface area of the container label) were compared with conventional medicine containers. Participants were shown various container label configurations, and ranked each on numerous preference dimensions. Results showed that participants judged the containers with the expanded surface area cap label more positively than standard medicine containers which lacked the added cap information. Wogalter, Magurno, Scott, and Dietrich (1996) performed research using

similar pharmaceutical containers. In this study, participants studied the information presented on either a conventional medicine container label or an expanded surface area OTC easy-open cap container label. After reading the medicine label, participants completed a knowledge test which asked questions about the information contained on the label. Results indicated that the easy-open cap labels produced significantly higher comprehension test scores than the conventional labels.

Pharmaceutical container labeling was also studied by Vigilante and Wogalter (1996), who investigated consumer preference for the ordering of component heading information on OTC drug labels. Information for different drugs was ranked in order of importance by undergraduates, adults, and senior citizens. Results showed that a relatively consistent information order existed across all drug types and participant populations. In general, participants preferred that medication labels first provide drug indications, then warnings (cautions and precautions) and use (directions), followed by information on active ingredients. Morrow, Leirer, Andrassy, and Tanke (1995) also studied the ordering of medication instruction components. In a series of experiments, Morrow and his colleagues had participants sort medication instruction items (e.g., purpose, dose, possible side effects, etc.) according to similarity and preference. Results demonstrated that older and younger adults possess a similar preference scheme, and that instructions that are compatible with the scheme improve memory for medication information.

Understanding how old and young adults process medication information was undertaken by Morrell, Park, and Poon (1989). In a series of experiments, participants first studied instructions printed on medication containers, and then completed a

questionnaire concerning the medication. Manipulated were amount of information presented, the time allowed to study the instructions (20 s vs. unlimited time), and the format of the information printed on the containers (conventional prescription medication format vs. highly ordered, salient format). Results demonstrated first of all, that older adults consistently manifested poorer recall than young adults, regardless of whether study time was controlled or self-paced. Second, both younger and older adults recalled less information from memory as more label information was presented. Finally, both old and young adults had substantial difficulty comprehending typical pharmacy-supplied drug information, but had little difficulty when the information was presented in a standard, highly organized format.

The emphasis on pharmaceutical warning labeling can be attributed to numerous factors, including the increasing elderly population, competition between drug manufacturers who are looking to gain a larger market share, and the switching of prescription medications to over-the-counter status, which places greater responsibility for medication selection and dosing on individual consumers. Research into the effectiveness of pharmaceutical labeling is important because the hazards associated with many kinds of drugs are not commonly known to the general public. Moreover, research consistently demonstrates that people want to be informed of the benefits and risks associated with pharmaceutical drugs. For example, Sojourner and Wogalter (in press) examined consumer preference for prescription medication information. Participants rated drug information sheets on various dimensions including ease of reading, ease of understanding, overall effectiveness, likelihood of reading, and overall preference. Across all dimensions, participants preferred the drug information sheets

which presented information in any combination of text and/or pictorials over a control sheet which presented no information. Kalsher, Wogalter, and Racicot (1996) similarly assessed consumer preference for medication container labels, and found that participants preferred and were likely to read and recommend medication information that was presented on alternative (tag and fold-out) formats. In a comprehensive study using actual medication materials, Morris and Olins (1984) conducted a mail survey of elderly consumers who received drug leaflets containing information for antihypertensives, tranquilizers, and arthritis medicines. Of those participants who said they received the leaflet, 95 percent read it, 76 percent kept it, and 56 percent discussed it with another person. Furthermore, respondents taking antihypertensives said they learned new information from the leaflets, and those taking tranquilizers said the leaflet made them feel better about using the drug.

Besides the benefit/risk information provided by physicians and other health care providers, other primary sources include medication container labels, supplementary printed information (e.g., drug information sheets, leaflets, patient product inserts, etc.), and advertising. However, these sources may fail to convey important information to the intended audience. For example, the print may be too small for persons without good visual acuity, which is a particular concern for older adults, who make up the largest consumers of pharmaceutical products. In addition, printed pharmaceutical warning messages may not be understandable to non-English speakers, or persons of lower literacy level. These circumstances, combined with the information processing gains attributed to text-pictorial messages, suggest that using pictorials to supplement pharmaceutical text messages may greatly facilitate the communication of medication

instructions.

Pharmaceutical Pictorials

Pictorials are beginning to be used more frequently on the printed materials which often accompany prescription medications. In addition to the physician's directions on drug container labels, pharmacists sometimes provide consumers with drug bottle stickers and/or separate medication information sheets. Pictorials are frequently used to supplement the printed materials, with the intention of aiding comprehension and compliance. Recent research has shown that some kinds of pictorials are successful at effectively communicating important pharmaceutical-related information and warnings. For example, Magurno et al. (1994) tested a diverse population group on the meanings of 30 USPC pharmaceutical pictorials, and found that 18 of the original pictorials met or exceeded the ANSI (1991) and ISO (1978) acceptable comprehension limits of 85% and 67%, respectively. Furthermore, upon redesign six more pictorials met the 85% comprehension criteria. Wolff and Wogalter (1993) performed similar testing using 28 of the 30 USPC pictorials, and found that all but five of the pictorials effectively communicated the intended message by surpassing the ANSI criterion. Ringseis and Caird (1995) performed comprehension testing on a set of pharmaceutical pictorials developed by the Pharmex Company, and found that nine of ten pictorials tested (either original or redesigned pictorials) surpassed the ISO (1978) criteria.

Not only do pharmaceutical pictorials seem to communicate medication information effectively, they are also preferred by consumers. For example, Kalsher et al. (1996) demonstrated that consumers believe pharmaceutical pictorials are helpful, and that they should be included on medication labels. Using preference dimensions

which included reading ease, likelihood of noticing, and likelihood of reading, Kalsher and his colleagues found that college students preferred drug bottle labels with pictorials to those labels without pictorials. Sojourner and Wogalter (1996) similarly demonstrated that participants preferred drug information sheets containing pictorials. Participants evaluated prescription medication instructions which differed in textual and pictorial presentation format. Using dimensions which included ease of reading, effectiveness, and preference, participants preferred a combined format which included text and associated redundant pictorials.

Unfortunately, many medication instructions have multiple components, and these components often represent complex concepts. For instance, the medical instruction "take one tablet two hours after meals" is an abstract, multiple-component concept. As discussed earlier, abstract concepts are not easily represented by pictorials that are comprehended at high levels. In fact, the instruction "take one tablet two hours after meals" is currently represented by a USPC pictorial which Magurno et al. (1994) has shown to be poorly understood. Unfortunately, poor comprehension could lead to "critical confusions," resulting in people understanding the opposite of what they should, and may lead people to perform the wrong behaviors. Wogalter (1994) cites an example of a critical confusion involving a pictorial designed for an acne medication which caused birth defects in the babies of women taking the drug during pregnancy. The acne drug pictorial showed a side-view outline shape of a pregnant woman within a circle-slash negation sign. The intended meaning of the pictorial was that women should not take the drug if they are pregnant. However, some women incorrectly interpreted the pictorial to mean that the drug might help in preventing pregnancy! As

can be seen, critical confusions are a particular concern when dealing with potentially hazardous pharmaceutical products.

Practical implications. Pharmaceutical product manufacturers recognize the need to avoid using poorly comprehended pictorials which do not adequately convey the intended message. As such, the printed material accompanying prescription medications often includes only an incomplete set of pictorials. That is, each and every textual instruction item may not be supplemented by an accompanying pictorial. Rather, the more concrete textual concepts may be accompanied by pictorials, while the complex and abstract instructions may be represented by text alone. For example, a medication information pamphlet containing nine printed pharmaceutical instructions might include only four instructions which represent concrete concepts. Accordingly, the four concrete text instructions may be accompanied by a pictorial, while the five more abstract concepts would be represented by text alone.

A potential problem in using a partial set of pictorials to accompany textual instructions is that people might overlook (not attend) those printed instructions which do not have an associated pictorial. Laughery, Young, Vaubel, and Brelsford (1993, pg. 55) found that pictorials can substantially improve noticeability, and serve to "reach out and grab people's attention." Similarly, Schmidt and Kysor (1987) describe some icons as being both attention-focusing and attention-getting, and Young and Wogalter (1990) state that pictorials increase a warning's noticeability. This suggests that people may readily attend to instructions accompanied by a pictorial, at the expense of those instructions printed as text only. In other words, attention may be drawn to those instructions accompanied by a pictorial, at the exclusion of the instructions without a

pictorial. Similarly, people may believe that only the most important instructions have associated pictorials, thereby judging the material without a pictorial as less important, and subsequently choosing not to read it.

Paivio's (1975) and Wickens' (1992) work suggests that the benefits gleaned from dual (redundant) coding may therefore not always result in facilitative effects. As suggested above, if people readily attend to dual-coded instructions (text accompanied by pictorials) at the expense of those that are single-coded (text only), little or no attention may be devoted to reading the text only instructions. Furthermore, even if attention is divided equally among the various instructions, dual code theory predicts that the single-coded instructions will be less efficiently processed, resulting in correspondingly poorer recall of the associated information. In either case, when listed in conjunction with redundant text/pictorial instructions, the information contained in text-only instructions has the potential for less than optimal processing, resulting in degraded comprehension and recall. This implies that using an incomplete set of pictorials to augment printed text instructions may in fact become more of a drawback than a benefit.

The present research evaluated the practice of providing pharmaceutical information via an incomplete (partial) set of pictorials. Medication instruction sheets were created that presented dosing instructions in the following formats: text alone, pictorials alone, fully redundant text and pictorials, text with one-half of the instructions accompanied by pictorials (incomplete pictorials), and no instructions (control). Following exposure to one of the instruction sheets, participants' comprehension and recall of the medication information was assessed, and subjective user preference ratings were collected.

Hypotheses

Comprehension and Memory

Participants exposed to the text instructions accompanied by a fully redundant set of pictorials should perform significantly better on a comprehension and memory tests than participants exposed to the other instruction formats. This is due to the information processing gains attributed to Dual Code Theory (and other similar information processing theories) discussed earlier. When the entire set of instructions were presented by text and pictorials, recall and understanding should be highest.

Performing next highest should be those participants exposed to the text alone format. The single-coded, text alone instructions provided more detail than the pictorials used alone, and thus performance should be higher than the other conditions, though not as high as the fully redundant, dual-coded text and pictorials condition.

The hypothesis of unique importance involves the instructions containing an incomplete set of pictorials. Across all instructions, this condition should result in intermediate-level test scores. However, the specific instructions without accompanying pictorials should result in low comprehension and recall (even more so than the corresponding instructions in the text alone condition). In other words, test performance involving questions that did not have an accompanying pictorial should be poorest. As stated earlier, it is believed that an incomplete set of pictorials should cause participants' attention to be drawn to those specific instructions associated with a pictorial, and participants should subsequently de-value those instructions not accompanied by a pictorial, concluding that they were less important. If true, these findings may identify a potential problem with the current practice of supplying consumers with incomplete sets

of pictorials to accompany medication information.

It was expected that participants exposed to the pictorials alone format would perform worse than the other instructional conditions. Actual pharmaceutical pictorials used to augment written instructions generally do not convey the same amount of detail that is often described by the associated text. Although pictorials normally aid in the acquisition of information, a consistent recommendation in the literature (e.g., Collins et al., 1982; Dewar, 1994) is the requirement not to use pictorials as a sole communication method, but rather to combine pictorials with text. In this experiment, it was believed that participants in the pictorials alone condition would not receive adequate information from the pictorials having no descriptive text, and the associated test results would be low.

Finally, as one might expect, the no instruction Control group should exhibit the lowest test scores, reflecting participants' lack of familiarity with the fictitious medication.

Ratings

The information sheet containing fully redundant text with pictorials should receive the highest subjective rating. As stated previously, people believe pictures are helpful, and think pictorials should be included on warning labels and other instructional materials. Furthermore, the potential information processing gains attributed to dual-coding may have been recognized by participants.

It was believed that the incomplete pictorials formats would result in the next highest ratings. Participants should find the pictorials appealing and helpful, even when presented as an incomplete set. The next highest rating (yet significantly lower than that

assigned to incomplete pictorials) should be associated with the text alone format. While text used alone was expected to be regarded as an effective way of facilitating comprehension and memory, the single- coded instructions should still be seen as inferior to a method that had at least some pictorials augmenting the text. If substantiated, the finding that participants believe an incomplete set of pictorials to be more effective than text used alone is important because it would contradict the results from the recall testing, where an incomplete set of pictorials was expected to be detrimental to comprehension and recall when compared with text alone. In a general sense, this may call attention to the dichotomy which sometimes exists between user preference and user performance, thereby emphasizing the need to collect objective measures when conducting warnings research.

To demonstrate that people do not simply desire pictorials in the absence of text to represent warning information, the sheets containing pictorials alone were expected to be rated poorly. Participants should realize that text was required to sufficiently describe the entire list of instructions, and thus the pictorials alone format was expected to be seen as an inadequate communication method.

Finally, the no instruction control format should be rated lowest of all formats, demonstrating participants' desire to be provided with additional information beyond that which was simply printed on a medication container label.

Method

Participants

Two hundred sixteen individuals participated, with 36 participants randomly assigned to six between-subjects conditions. Participants represented a broad range of demographic variables including gender, age, occupation, and education. One third of the participants (Adults, mean age = 33.6 years old, 46% male) were collected from the public at-large e.g., a flea market, a shopping center, churches, and a community college. Another third were comprised of older adults (Elders, mean age = 68 years old, 35% male) who volunteered through the North Carolina State University Center for Lifelong Enrichment. The use of older participants was critical since they tend to consume more medications than other population groups, and because declining visual and cognitive difficulties may decrease their ability to read and understand pharmaceutical information. The final group of participants were comprised of college students (Undergraduates, mean age = 19.0 years old, 26% male) from the PSY 200 subject pool. As remuneration for participating, the Adults and Elders received \$10 each, and the Undergraduates received partial course credit.

Materials

Drug Information Sheets

Six different instruction sheets for a fictitious drug were created (see Appendix A). The instruction sheets were modeled after those supplied by various pharmaceutical supply companies and drug manufacturers. The drug name was printed at the top of each instruction sheet, followed by a drug purpose statement. Below the drug purpose statement were printed the following eight medication instructions that specified the

directions and warnings for drug use. Each medication instruction was comprised of two parts - a directive, and an explanation:

- (1) Do not take with milk or other dairy products. Dairy products interfere with absorption of this medication.
- (2) The shelf life of this medication will be extended if stored at temperatures less than 50 degrees. Store in refrigerator.
- (3) Do not take other medicines with this medicine. This medicine reacts negatively with numerous other drugs.
- (4) This medication may cause unrest and sleeplessness. Do not take at bedtime.
- (5) This medication has been precisely measured, and it is important that each tablet be taken in whole form. Do not break or crush tablets or caplets.
- (6) Wash hands. This medication is readily absorbed through the skin, and hands should be washed immediately after taking the medicine.
- (7) Take until gone. Even though disease symptoms may disappear in a few days, all of this medication must be taken to avoid disease recurrence.
- (8) This medication may cause dehydration. Take with a glass of water.

The pharmaceutical instructions were obtained through medication literature (e.g., Berkow, 1982; Gahart, 1985), and by interviews with health care professionals (i.e., nurses and pharmacists). An attempt was made to use less familiar instructions to avoid instances where high levels of prior knowledge influenced recall test scores. In other words, a common instruction like "do not take if pregnant" was not used since

most people could guess that directive correctly without ever being exposed to the instruction sheets. A fictitious drug name and purpose were used to assure that participants had no prior knowledge or experience with the medication.

The instruction sheets presented the information in one of six formats:

- (1) Text Alone
- (2) Pictorials Alone
- (3) Text and Pictorials
- (4) Incomplete Pictorials 1 (text with four of the eight instructions having an associated pictorial)
- (5) Incomplete Pictorials 2 (text with the other four instructions having an associated pictorial)
- (6) No Instructions (Control Condition).

In the text and pictorials format, each printed textual instruction was accompanied by an associated pictorial. Text was printed in list format, with pictorials located to the immediate left of the corresponding text. In the text alone format, only the eight textual instructions were shown, and pictorials were omitted. Alternatively, in the pictorials alone format, only the eight pictorials were shown, and text was omitted. In the incomplete pictorials formats (1 and 2), two versions of the drug information sheet were created with half of the instructions having an associated pictorial. Incomplete Pictorials 1 included pictorials for the randomly selected instructions 1, 3, 4, and 7. Incomplete Pictorials 2 included pictorials for instructions 2, 5, 6, and 8. The no-instruction control format contained only the drug name and purpose (no instructions were shown),

serving as a base line of medication-instruction knowledge without benefit of instructions, which enabled an assessment of knowledge gained from exposure to the experimental materials.

The drug information sheets were standard 21.6 cm (8.5 in.) x 27.9 cm (11.0 in.) white bond paper with information printed on one side. The drug name was printed in 14-point Times font, and the drug purpose and instructions were printed in 12-point Times font. Pictorials were approximately 1.9 cm² (.75 in.²). The pictorials were taken from a set developed for the USPC that have been tested to have comprehension levels of at least 85%. Pictorials depicted the action to be completed when complying with the directive portion of each medication instruction.

Medication Bottle

A medication bottle was used in order to create a situation similar to one in which actual medication and drug information sheets are distributed. The label affixed to the medication bottle is shown at Appendix B, and was modeled after those distributed by a local pharmacy. The following fictitious information was included on the label: (a) drug name and quantity, (b) refill information and expiration date, (c) pharmacy name, address, and phone number, (d) prescribing doctor's name, and (e) dosage instructions reading "take one tablet three times per day." The information was printed in 12-point Times font, and was affixed to a standard 7.0 cm (2.75 in.) tall prescription medication bottle.

Consent Form

An Informed Consent Form was completed by each participant (shown at Appendix C).

Demographics Questionnaire

A questionnaire soliciting demographic information and opinions regarding prescription medications was completed by each participant (shown at Appendix D).

Comprehension and Memory Test

To assess understanding and recall for the drug information, all participants completed a two page Comprehension and Memory Test (shown at Appendix E). The test was comprised of two parts. Part I was a free recall test, requiring the participants to recall as many of the eight medication instructions as possible. Part II was a cued recall (short answer) test, with the following eight questions corresponding to the eight medication instructions:

- (1) When is it okay to take other medicines with this medicine? Please explain.
- (2) What liquid should be used to take the medicine? Why?
- (3) Where should the medicine be stored? Why?
- (4) At what time of day should you **NOT** take the medicine? Why?
- (5) Should you take the medicine with milk? Why or why not?
- (6) When taking the medication, when should your hands be washed? Why?
- (7) When is it okay to break the tablets in half? Please explain.
- (8) For how long should you take the medicine? Why?

Text was printed in 12-point Times font on standard 21.6 cm (8.5 in.) x 27.9 cm (11.0 in.) white bond paper with information printed on one side. Part I was printed on test page 1, and Part II was printed on test page 2.

Reliability and validity. To assess reliability and validity of the Comprehension and Memory Test, analyses were performed using test scores from 36 undergraduate pilot

participants, each of whom were exposed to one of the six drug information sheet formats.

Mean scores and standard deviations for the free recall portion of the Comprehension and Memory Test are shown in Table 1, and reflect the expected differential distribution of scores across the six drug information sheets.

For the cued recall portion of the Comprehension and Memory Test, item analyses were performed and are shown at Appendix H. Once again, a differential distribution of scores across the six drug information sheets was obtained, with internal consistency confirmed by a Kuder-Richardson coefficient of .7482.

Table 1

Free Recall Mean Scores and Standard Deviations
for Pilot Participants (n=36)

Drug Information Sheet Format	Mean Score (SD)
Text and Pictorials	9.5 (2.3)
Text Alone	8.8 (1.9)
Incomplete Pictorials 2	8.2 (1.7)
Incomplete Pictorials 1	7.2 (2.5)
Pictorials Alone	5.2 (1.6)
Control	0.0 (0.0)

Ratings Form

All participants completed a subjective ratings form (shown at Appendix F) which

asked the question, "How effective was the drug information sheet at helping you understand and remember the medication instructions?" A five point Likert scale was used with the following response anchors: (1) not at all effective, (2) somewhat effective, (3) effective, (4) very effective, and (5) extremely effective. A rating was assigned to each of the drug information sheets. The ratings form was printed in 12-point Times font, using standard 21.6 cm (8.5 in.) x 27.9 cm (11.0 in.) white bond paper.

Procedure

All proceduralized instructions were read to the participants by the experimenter, and the verbatim text is attached at Appendix G.

Comprehension and Memory

Participants were first greeted by the experimenter, and a short introduction explaining the nature of the study was read. Participants then read and signed the Informed Consent Form (Appendix C). To provide as much realism as possible, participants were then read the following scenario:

"To set the stage for the study, I would like you to pretend that you've just left your doctor's office. Although your visit to the doctor was for a routine physical, tests revealed that you have a serious illness. While the illness can be treated with medication, the diagnosis came entirely out of the blue, and frankly, you are a little nervous and anxious about the illness, and the medication prescribed to treat it. You are unfamiliar with the drug your doctor prescribed, and have now come to your local pharmacy to get the prescription filled. You will be receiving a filled medication bottle, and a drug information sheet. Each will contain various

instructions regarding proper use of your medication. After reviewing the label on the bottle and the drug information sheet, you will be asked various questions about the information to you. Do you have any questions at this time?"

Participants were then handed a plastic prescription drug container containing placebo tablets (to simulate a medication purchase), and were told to examine the label (see Appendix B) as if it were handed to them by an actual pharmacist. Next, participants were informed that they would be receiving a drug information sheet which would provide them with additional information and instructions about the drug. Participants were also informed that they would have 60 s to examine the information on the sheet, and that they should quickly examine and familiarize themselves with the information since they would later be asked questions about it. Participants were then handed a drug information sheet corresponding to one of the six experimental formats (randomly assigned), and were timed while they reviewed the information. After 60 s had elapsed, the sheets were collected. While the time limit and directions to quickly review the information created a certain degree of artificiality, it is recognized here that some tradeoff between experimental control and the applied nature of actual prescription medication purchases exists and is warranted. The 60 s time limit was selected based on preliminary pilot trials.

Following exposure to the instruction sheet, participants completed the Demographics Questionnaire (Appendix D). The questionnaire was used to collect participants' demographic information and opinions regarding prescription medications. It also served as a filler task, creating a non-rehearsal distracter which prevented the

information on the drug information sheet from being retained in short-term memory.

The questionnaire took approximately five min to complete.

Upon completion of the questionnaire, participants were given the Comprehension and Memory Test (Appendix E). Time to complete the test varied for each participant, with times generally ranging from 10 to 20 mins.

Ratings

After completing the Comprehension and Memory Test, participants were shown the entire set of six drug information sheets. The sheets were arranged on a table in front of the participants, with the order of presentation randomly determined. After reviewing all of the drug information sheets, the participants completed the Ratings Form (Appendix F).

Finally, participants were debriefed and any questions were answered. Participants were then remunerated for their time, and were released.

Design

Comprehension and Memory

Participant Group served as one between-subjects independent variable with the following three levels: (1) Undergraduates, (2) Adults, and (3) Elders.

Sheet Format served as a second between-subjects independent variable with six levels corresponding to the six information presentation methods discussed previously:

Format 1 - Text Alone

Format 2 - Pictorials Alone

Format 3 - Text and Pictorials

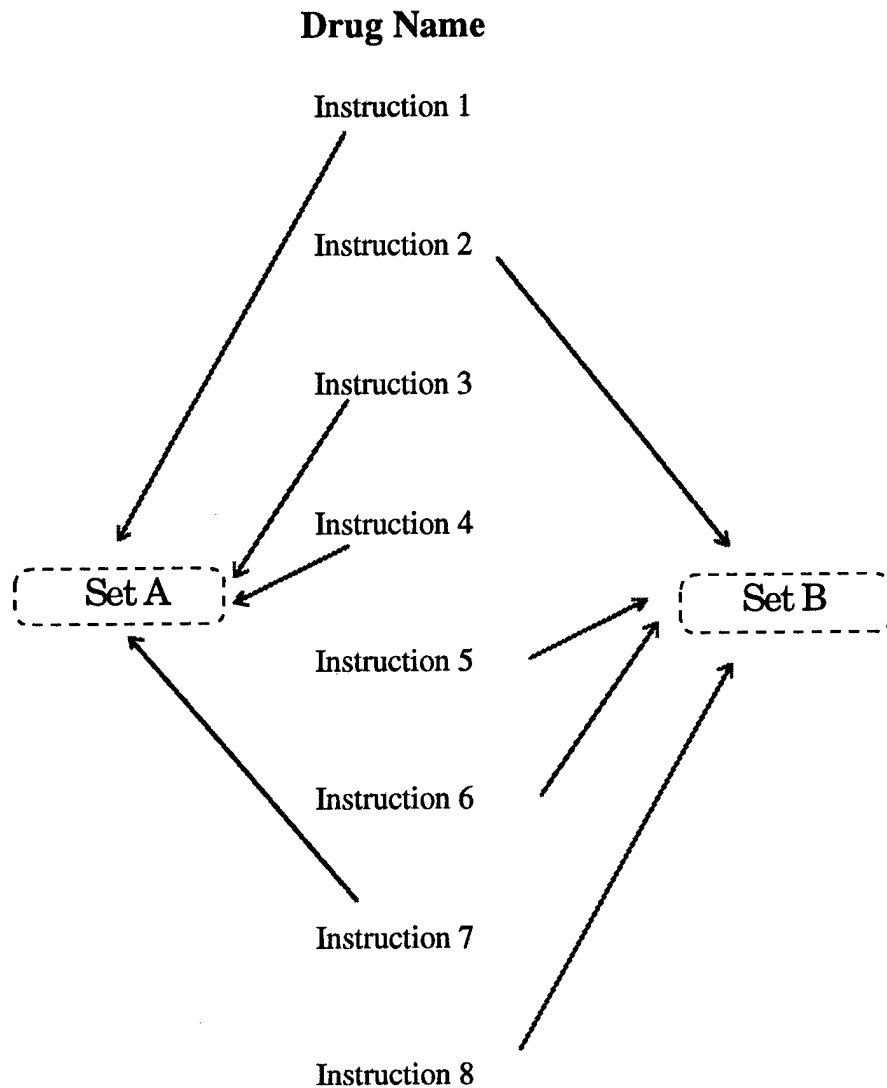
Format 4 - Incomplete Pictorials 1

Format 5 - Incomplete Pictorials 2

Format 6 - No Instructions

A variable titled Set served as a within-subjects independent variable. Four of the eight instructions comprised Set A, and the four remaining instructions comprised Set B. This distinction corresponded to the four instructions accompanied by pictorials in the incomplete pictorials instruction sheets (Formats 4 and 5). Figure 1 illustrates this grouping, showing Set A containing instructions 1, 3, 4, and 7, and Set B containing instructions 2, 5, 6, and 8.

The Set distinction became critical when evaluating the incomplete pictorials formats. Therefore, in Format 4 (Incomplete Pictorials 1), Set A instructions were accompanied by a pictorial, while Set B instructions were not. Conversely, in Format 5 (Incomplete Pictorials 2), Set B instructions were accompanied by a pictorial, while Set A instructions were not (refer to Appendix A for actual instruction sheet layouts). The Set categorization allowed for a specific comparison of uniquely coded instructions across different sheet formats. For example, Set B instructions from Sheet Format 4 (text instructions from an incomplete pictorial sheet) could be compared with Set B instructions from Sheet Format 1 (the same text instructions from the text alone sheet) to determine if manipulating overall sheet format resulted in differential comprehension and recall of identical instructions.



Format 1: Sets A and B are text .

Format 2: Sets A and B are pictorials

Format 3: Sets A and B are text with pictorials

Format 4: Set A is text with pictorials. Set B is text

Format 5: Set A is text. Set B is text with pictorials

Format 6: No instructions are included

Figure 1. Schematic showing Set categorization.

Question Composition served as another within-subjects independent variable with the following two levels: (1) Directive, and (2) Explanation. Since each drug information sheet instruction was comprised of both a directive and an explanation, this distinction allowed an inspection into which (if any) question component was most readily recalled.

Dependent measures included scores on the Comprehension and Memory Test. Analyses were performed separately on the free recall and cued recall portions of the test to determine if there were any differential results.

Ratings

Participant Group served as one between-subjects independent variable with the following three levels: (1) Undergraduates, (2) Adults, and (3) Elders.

First Exposure served as a second between-subjects independent variable with six levels corresponding to the six information presentation methods discussed previously. Assignment of this variable allowed analyses into the effects of comprehension and memory testing on subjective ratings.

Sheet Format served as a within-subjects independent variable. The six information presentation methods discussed previously comprised the six levels of the independent variable. The Likert-scale subjective ratings served as dependent variables.

Results

As mentioned previously, each of the drug information sheet instructions were comprised of two distinct parts - a directive (e.g., "Do not take at bedtime") and an explanation (e.g., "This medication may cause unrest and sleeplessness"). Accordingly, scoring of the Comprehension and Memory Test was based on a maximum of 2 points per instruction. Responses that included both the directive and explanation were awarded 2 points, while responses that contained either the directive or the explanation were awarded 1 point. Non-responses, or those which were incorrect, were given 0 points. The scoring criteria were lenient in that responses did not have to specifically match the exact wording found on the drug information sheet. Instead, a directive and/or explanation was counted correct if synonymous with the instruction provided, thereby indicating participants' basic understanding and recall of the medication instruction. The 0-2 point scoring system was used for both the free recall and cued recall portion of the Comprehension and Memory Test, with 16 points (8 instructions at 2 points per instruction) being the maximum allowable score per test.

To ensure validity of the test scoring procedure, a training session was undertaken by two judges who established common scoring criteria and procedures. One third of the Comprehension and Memory Tests were then randomly selected and scored by both judges. The judges scored the tests without knowing the conditions from which they were taken (i.e., blind). Inter-rater reliability was found to be 90.8%. Subsequently, the remaining tests were scored by only one judge, and the data reported here are based on that judge's scoring procedure.

Free Recall

Free recall test score means and standard deviations for the variables Participant Group (Undergraduates, Adults, Elders) and Sheet Format (Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials 1, Incomplete Pictorials 2, Control) are contained in Table 2. Note that Table 2 lists the means for both of the incomplete pictorials sheet formats. Most of the analyses performed in this study combine the data from Incomplete Pictorials 1 and 2 into one overall Incomplete Pictorials condition. Later analysis will, however, explore the differences between the two incomplete pictorials formats.

Table 2

Free Recall Means (SD) for Participant Group and Sheet Format

	<u>Undergraduates</u>	<u>Adults</u>	<u>Elders</u>	<u>Total</u>
Text Alone	10.83 (2.59)	8.67 (1.92)	4.33 (2.31)	7.94 (3.13)
Pics Alone	4.75 (1.29)	4.92 (2.11)	2.42 (2.39)	4.03 (1.93)
Text & Pics	11.08 (2.43)	9.83 (2.17)	6.50 (2.54)	9.14 (3.03)
Inc. Pics 1	9.50 (2.20)	7.33 (2.23)	4.08 (2.78)	6.97 (2.40)
Inc. Pics 2	9.33 (2.90)	8.92 (3.09)	5.08 (2.11)	7.78 (3.29)
Control	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)

Incomplete Pictorials Combined

Main Effects. A 3 (Participant Group: Undergraduates, Adults, Elders) x 5 (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials,

Control) between-subjects Analysis of Variance (ANOVA) was performed. The ANOVA showed a significant main effect of Participant Group, $F(2,201) = 50.88$, $p < .0001$, with Tukey's Honestly Significant Difference (HSD) test ($p < .05$) showing that all groups were significantly different from each other. Scores were highest for the Undergraduates ($M = 7.24$), followed by the Adults ($M = 6.31$), with the Elders ($M = 3.57$) performing poorest. This pattern of means is depicted in Figure 2.

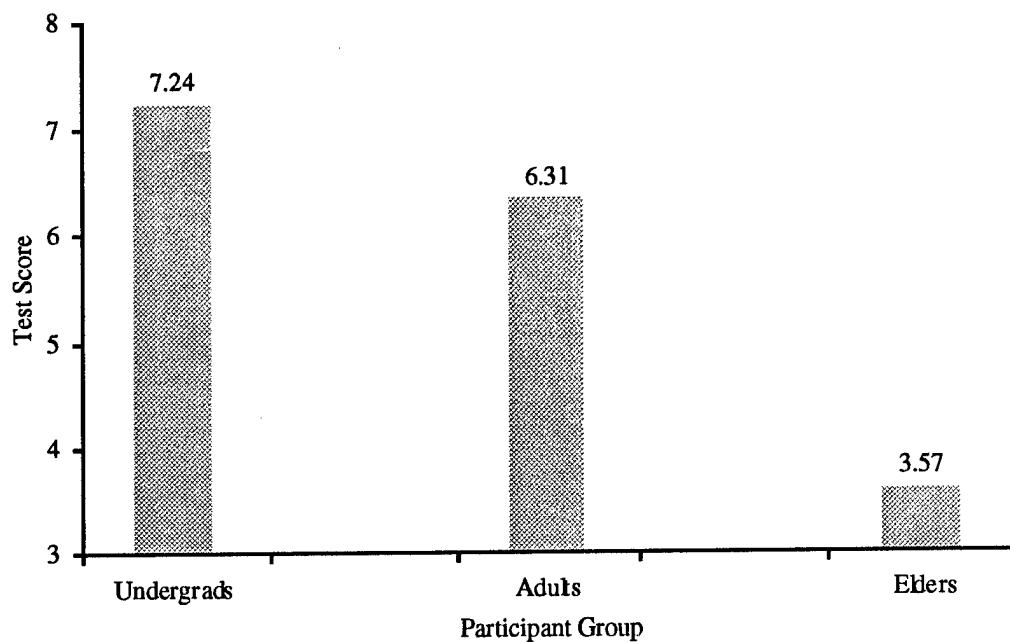


Figure 2. Free recall means for Participant Group.

The ANOVA also showed a significant main effect of Sheet Format, $F(4, 201) = 116.16$, $p < .0001$, with Text and Pictorials performing highest ($M = 9.14$), followed in descending performance order by Text Alone ($M = 7.94$), Incomplete Pictorials ($M = 7.38$), Pictorials Alone ($M = 4.03$), and Control ($M = 0.00$). Tukey's HSD test ($p < .05$)

confirmed that all sheet formats were significantly different from one another, except for Text Alone and Incomplete Pictorials, which did not differ. This pattern of means can be seen in Figure 3.

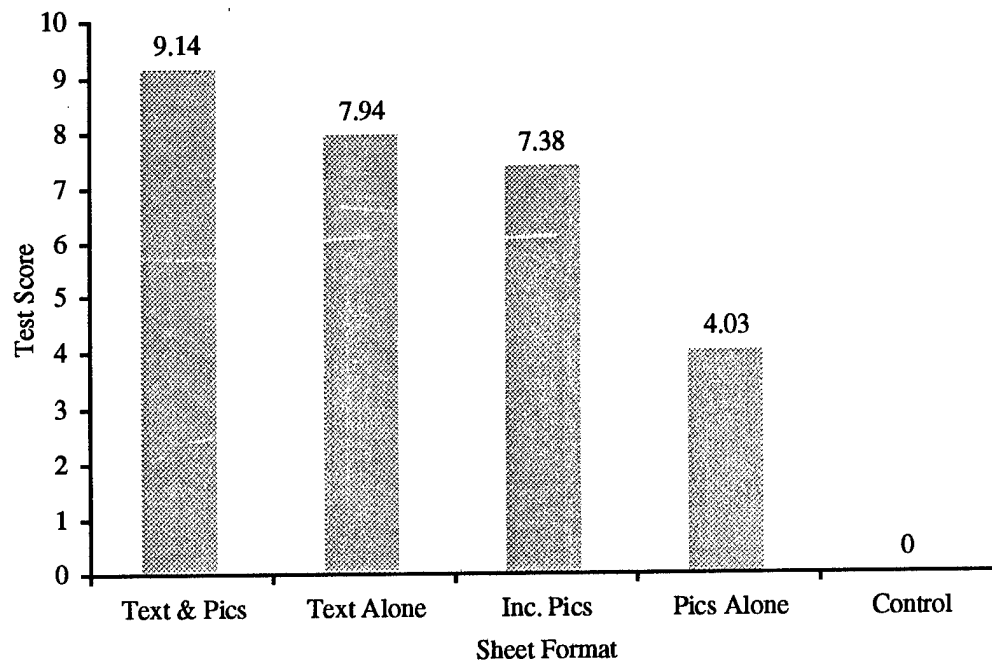


Figure 3. Free recall means for Sheet Format.

Interaction. The ANOVA also showed a significant two-factor interaction of Participant Group and Sheet Format, $F(8,201) = 4.74$, $p < .0001$. This interaction can be seen by inspecting the means for the different sheet formats shown in Figure 4. The pattern of means show that for every sheet format except Pictorials Alone and Control, the Undergraduates recalled the most information, followed by the adults, with recall by

the Elders being poorest. In the Pictorials Alone condition, the Undergraduates and Adults did not differ, and in the Control condition, none of the groups differed. This pattern was supported by Tukey's HSD test ($p < .05$).

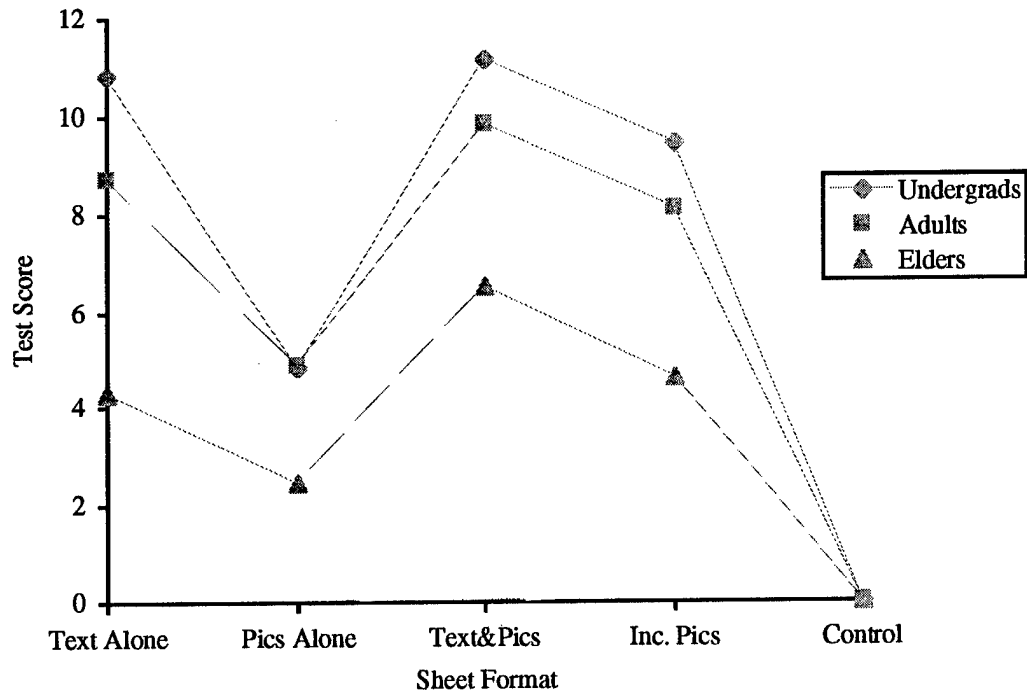


Figure 4. Free recall means for Sheet Format by Participant Group.

Directive vs. Explanation

Main effects. As discussed previously, each drug information sheet instruction was comprised of two distinct parts - a directive and an explanation. To determine if differential recall for the two instructional components existed, a 3 (Participant Group: Undergraduates, Adults, Elders) x 5 (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials, Control) x 2 (Question Composition: Directive,

Explanation) mixed model ANOVA was performed. In addition to the Participant Group and Sheet Format effects discussed above, the ANOVA also showed a main effect of Question Composition, $F(1, 201) = 435.82, p < .0001$, with Directives ($M = 4.04$) recalled more often than Explanations ($M = 1.66$).

Interaction. The ANOVA also showed a significant two-factor interaction of Sheet Format and Question Composition, $F(4, 201) = 31.51, p < .0001$. This interaction can be seen by inspecting the Directive vs. Explanation means shown in Figure 5. The pattern of means show that while there was a substantial decline in recall for the instruction explanation compared to the instruction directive for all sheet conditions (except the Control condition, where there was zero recall for Directive and Explanation), the decline was more pronounced in the Pictorials Alone condition, where the Explanation mean score dropped nearly to zero. This pattern was supported by Tukey's HSD test ($p < .05$).

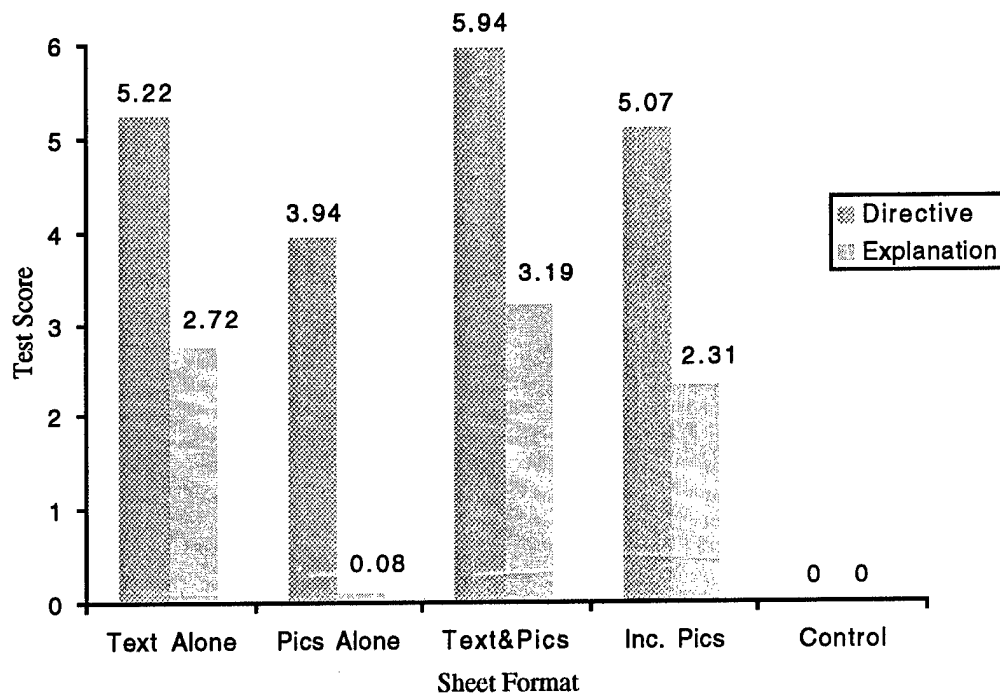


Figure 5. Free recall interaction between Question Composition and Sheet Format.

Set

As previously discussed, a variable titled Set was used to delineate those instructions within an Incomplete Pictorial sheet which were or were not accompanied by pictorials. Considering the eight instructions on a sheet as being numbered 1-8 from top to bottom, Set A encompassed instructions 1, 3, 4, 7, and Set B encompassed instructions 2, 5, 6, 8. In the Text Alone, Pictorials Alone, and Text and Pictorials sheets, Sets A and B were presented in the same format (e.g. in the Text Alone sheet, instructions 1, 3, 4, and 7 were text, as were instructions 2, 5, 6, and 8). This was not the case in the Incomplete Pictorials sheets. In Incomplete Pictorials Sheet 1, Set A text was accompanied by pictorials and Set B text was not. Conversely, in Incomplete

Pictorials Sheet 2, Set B text was accompanied by pictorials and Set A text was not (refer to Figure 1 for graphical illustration of the Set formats). In general, this distinction enabled a within-subjects analysis of groups of instructions (some with pictorials versus others without) across all sheet conditions.

Main effects. A 3 (Participant Group: Undergraduates, Adults, Elders) x 6 (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials 1, Incomplete Pictorials 2, Control) x 2 (Set: A, B) mixed model ANOVA was performed. The ANOVA showed a main effect of Participant Group, $F(2,198) = 61.39$, $p < .0001$, with Tukey's HSD test ($p < .05$) confirming that the Undergraduates scored highest, followed by the Adults, with the Elders scoring lowest (means are the same as those depicted in Figure 2). The ANOVA also showed a main effect of Sheet Format, $F(5,198) = 88.51$, $p < .0001$, with Text and Pictorials performing highest ($M = 9.14$), followed in descending scoring order by Text Alone ($M = 7.94$), Incomplete Pictorials 2 ($M = 7.78$), Incomplete Pictorials 1 ($M = 6.96$), Pictorials Alone ($M = 4.03$), and Control ($M = 0.00$). Post-Hoc analysis using Tukey's HSD test ($p < .05$) showed that all formats differed significantly from each other except between Text Alone and Incomplete Pictorials 1 and 2. Finally, the ANOVA showed a main effect of Set, $F(1, 198) = 7.047$, $p < .01$, with test scores higher for Set A ($M = 3.16$) than Set B ($M = 2.81$).

Interactions. Figure 6 shows the pattern of means for each sheet condition as a function of Set. While no significant interactions were present, a trend in these data are worth noting. Set A instructions were recalled more often than Set B instructions for every sheet format **except** Incomplete Pictorials 2, where Set B instructions (text

accompanied by a pictorial) were recalled more often than Set A instructions (text unaccompanied by a pictorial).

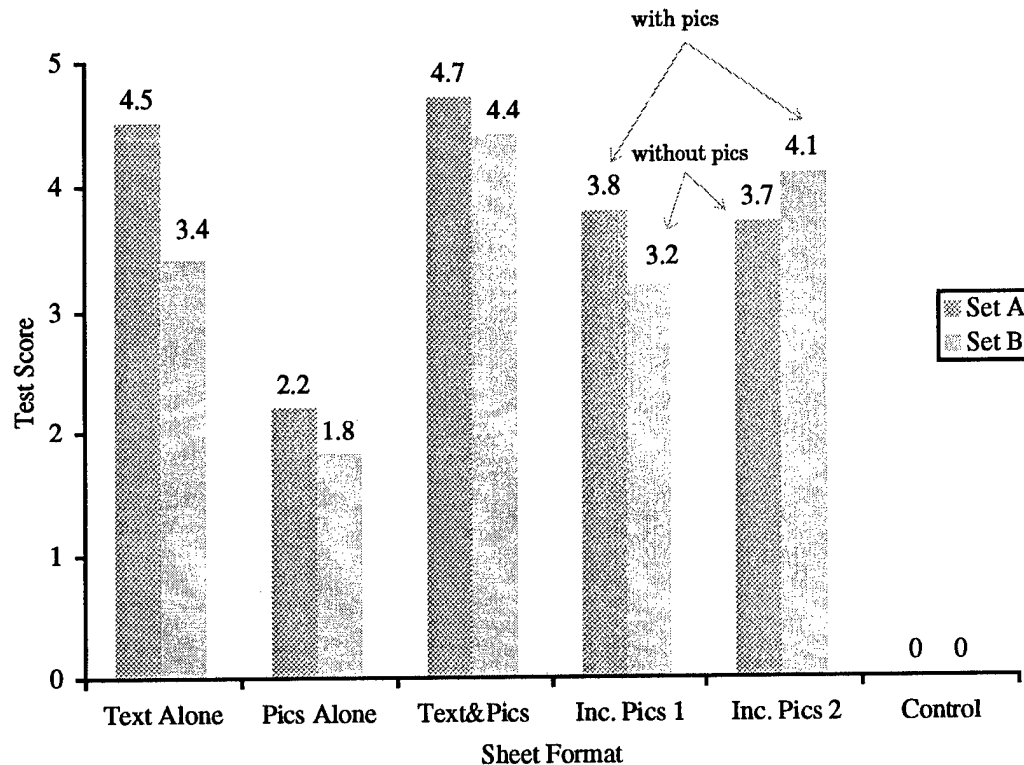


Figure 6. Free recall means for Sheet Format and Set.

Individual Instructions

A repeated measures ANOVA was performed using the recall scores associated with the eight individual drug information sheet instructions. While this was not an original objective for the study, the previous analysis which demonstrated a difference in Set A and Set B suggested an exploratory analysis on the individual instruction items. The ANOVA showed a significant difference in recall among the instructions,

$F(7,1505) = 15.91, p < .0001$. Table 3 lists mean recall scores for each instruction in descending performance order.

Table 3

Free Recall Means for Each Instruction

Instruction	Set	Description	Mean Score
8	B	Take with water	.995
4	A	Not at bedtime	.912
7	A	Take until gone	.889
1	A	Not with milk	.741
6	B	Wash hands	.667
5	B	Don't break tablets	.648
3	B	Not with other meds	.630
2	A	Refrigerate	.500

Post-hoc analysis of the means using Tukey's HSD test ($p < .05$) showed that instructions 8 (Set B), 4 (Set A), and 7 (Set A) were recalled significantly more often than the other instructions, with no difference among those instructions. Therefore, two of the three instructions remembered most were both Set A instructions. Also, a non-significant trend was apparent, in that three of the four instructions with the highest recall scores were in Set A, while three of the four instructions with the lowest recall scores were in Set B.

Incomplete Pictorials Omitted

Main effects. To fully understand the interplay between text and pictorials, a 2 (Text: Present, Absent) x 2 (Pictorials: Present, Absent) between-subjects ANOVA was performed which omitted scores from the Incomplete Pictorials conditions. The ANOVA showed a main effect of Text, $F(1,140) = 229.65, p < .0001$, with test scores higher when text was present ($M = 8.54$) than when text was absent ($M = 2.01$). There was also a main effect of Pictorials, $F(1, 140) = 36.74, p < .0001$, with test scores higher when pictorials were present ($M = 6.58$) than when they were absent ($M = 3.97$).

Interactions. The ANOVA also showed a significant two-factor interaction of Text and Pictorials, $F(1, 140) = 10.82, p < .05$. This interaction can be seen by inspecting the means shown in Figure 7. By first comparing the difference between Pictorials Present and Pictorials Absent, the pattern of means show an apparent (yet non-significant) drop in scores when pictorials were omitted from the Pictorials Present/Text Present sheet (from $M = 9.14$ to $M = 7.94$), and a larger, significant drop in scores when pictorials were omitted from the Pictorials Present/Text Absent sheet (from $M = 4.03$ to $M = 0.0$). When inspecting the Text Present and Text Absent conditions, removing text from the Text Present/Pictorials Present sheet resulted in a significant, yet smaller drop in scores (from $M = 9.14$ to $M = 4.03$) than did removing text from the Text Present/Pictorials Absent sheet (from $M = 7.94$ to $M = 0.0$). This pattern was supported by Tukey's HSD test ($p < .05$).

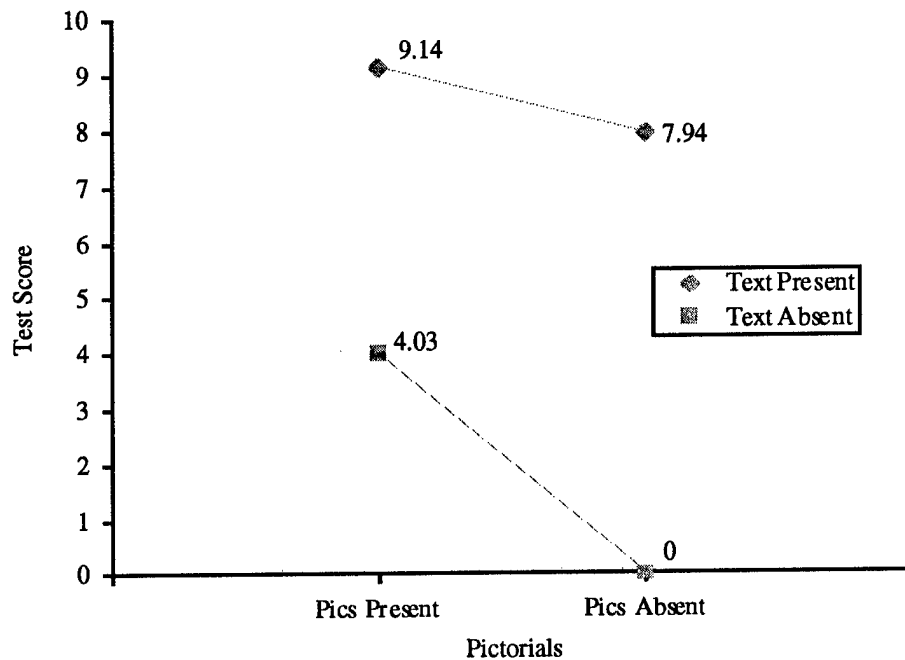


Figure 7. Free recall interaction between text and pictorials.

Cued Recall

Cued recall test score means and standard deviations for the variables Participant Group (Undergraduates, Adults, Elders) and Sheet Format (Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials 1, Incomplete Pictorials 2, Control) are listed in Table 4. The pattern of means are similar to those obtained from the free recall test (shown in Table 2).

Incomplete Pictorials Combined

Main Effects. A 3 (Participant Group: Undergraduates, Adults, Elders) x 5 (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials, Control) between-subjects ANOVA was performed. In this design, the scores from the

two incomplete pictorials sheets were combined into one overall Incomplete Pictorials condition. The ANOVA showed a significant main effect of Participant Group, $F(2,201) = 15.22, p < .0001$, with Tukey's HSD test ($p < .05$) showing no significant difference between the Undergraduates ($M = 9.34$) and Adults ($M = 8.66$), with those groups scoring higher than the Elders ($M = 7.24$). This pattern of means is depicted in Figure 8.

Table 4

Cued Recall Means (SD) for Participant Group and Sheet Format

	<u>Undergraduates</u>	<u>Adults</u>	<u>Elders</u>	<u>Total</u>
Text Alone	13.42 (1.93)	12.42 (1.98)	10.50 (2.65)	12.11 (2.47)
Pics Alone	6.50 (1.24)	6.33 (1.78)	4.08 (2.35)	5.64 (2.11)
Text & Pics	13.08 (2.35)	12.67 (2.27)	11.42 (2.68)	12.34 (2.48)
Inc. Pics 1	12.50 (2.07)	11.33 (2.23)	9.75 (3.47)	11.19 (2.83)
Inc. Pics 2	12.58 (2.50)	11.92 (3.23)	10.33 (2.54)	11.61 (2.86)
Control	1.17 (1.80)	0.25 (0.87)	0.17 (0.58)	0.53 (1.25)

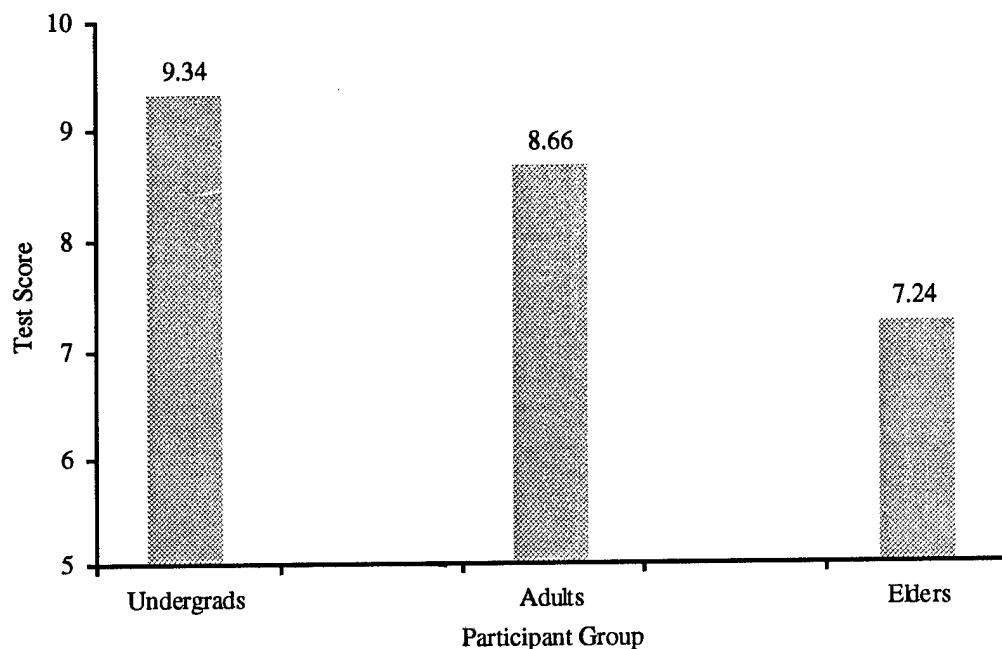


Figure 8. Cued recall means for Participant Group.

The ANOVA also showed a significant main effect of Sheet Format, $F(4, 201) = 215.51, p < .0001$, with Text and Pictorials performing highest ($M = 12.39$), followed in descending performance order by Text Alone ($M = 12.11$), Incomplete Pictorials ($M = 11.40$), Pictorials Alone ($M = 5.64$), and Control ($M = 0.53$). The pattern of means can be seen in Figure 9. Post-hoc analysis using Tukey's HSD test ($p < .05$) showed no difference between Text and Pictorials, Text Alone, and Incomplete Pictorials. However, those formats were significantly higher than Pictorials Alone, with Control scoring significantly lower than all other formats. The ANOVA showed no interaction between Participant Group and Sheet Format.

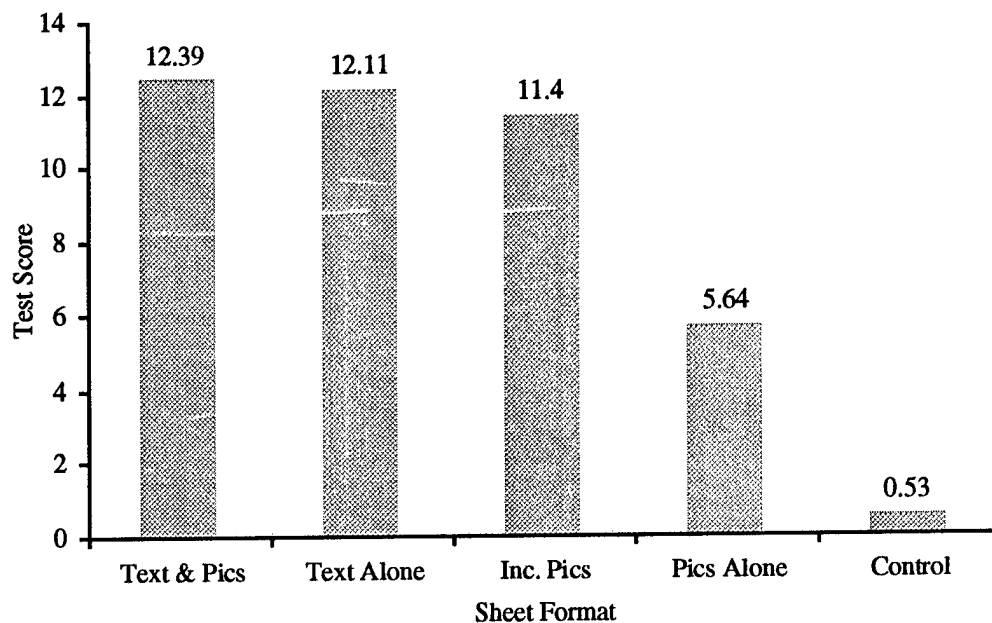


Figure 9. Cued recall means for Sheet Format.

Directive vs. Explanation

Main effects. A 3 (Participant Group: Undergraduates, Adults, Elders) x 5 (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials, Control) x 2 (Question Composition: Directive, Explanation) mixed model ANOVA was performed. In addition to the Participant Group and Sheet Format effects discussed above, the ANOVA also showed a main effect of Question Composition, $F(1, 201) = 631.16$, $p < .0001$, with Directives ($M = 5.57$) recalled more often than Explanations ($M = 2.84$).

Interaction. The ANOVA also showed a significant two-factor interaction of Sheet Format and Question Composition, $F(4,201) = 41.36$, $p < .0001$. This interaction can be seen by inspecting the Directive vs. Explanation means shown in Figure 10. The

pattern of means show that while there was a substantial decline in recall for the Explanation compared to the Directive for all sheet conditions (except the Control condition, where performance was low for both Directive and Explanation), the decline was more pronounced in the Pictorials Alone condition, where the Explanation mean score dropped nearly to zero.. This pattern was supported by Tukey's HSD test ($p < .05$).

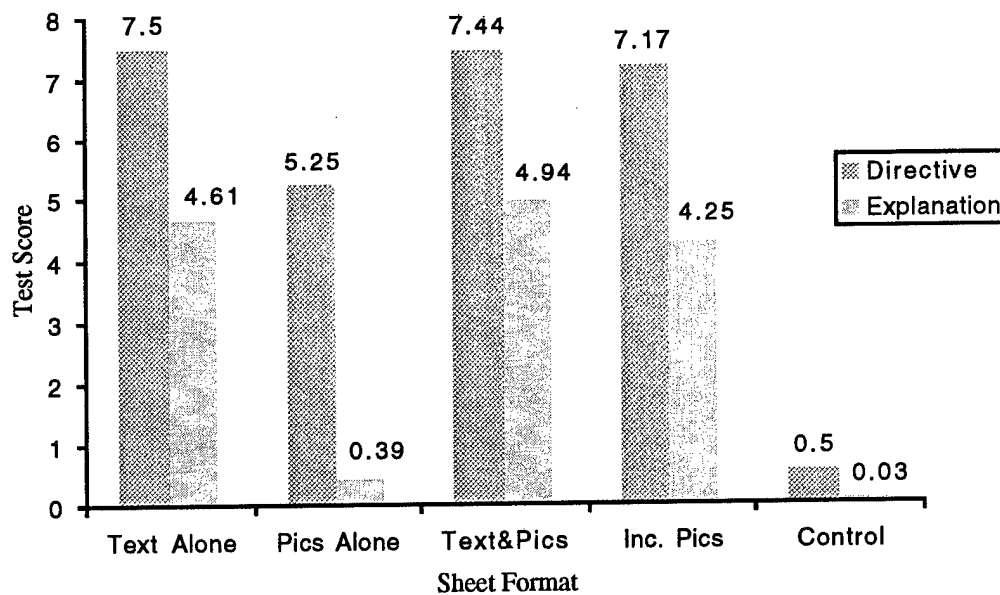


Figure 10. Cued recall interaction between Question Composition and Sheet Format.

Set

Main effects. A 3 (Participant Group: Undergraduates, Adults, Elders) x 6 (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials 1, Incomplete Pictorials 2, Control) x 2 (Set: A, B) mixed model ANOVA was performed. The ANOVA showed a main effect of Participant Group, $F(2,198) =$

17.25, $p < .0001$, with Tukey's HSD test ($p < .05$) confirming once again that the Elders scored significantly lower than the Undergraduates and Adults, with no difference between Undergraduates and Adults (means are the same as those depicted in Figure 8). The ANOVA also showed a main effect of Sheet Format, $F(5,198) = 164.16$, $p < .0001$, with Text and Pictorials performing highest ($M = 12.38$), followed in descending scoring order by Text Alone ($M = 12.12$), Incomplete Pictorials 2 ($M = 11.62$), Incomplete Pictorials 1 ($M = 11.20$), Pictorials Alone ($M = 5.64$), and Control ($M = 0.52$). Post-hoc analysis using Tukey's HSD test ($p < .05$) showed that all formats differed significantly from each other except between Text and Pictorials, Text Alone, and Incomplete Pictorials 1 and 2.

Interactions. The ANOVA also showed a significant two-factor interaction of Participant Group and Set, $F(2,198) = 3.48$, $p < .05$. This interaction can be seen by inspecting the Set means shown in Figure 11. The pattern of means (confirmed by Tukey's HSD test, $p < .05$) show that for the Undergraduates, Set A test scores were significantly higher than Set B test scores. Set A and B test scores for the Adults and Elders were not significantly different. There was a small but nonsignificant trend showing Set B scores slightly higher than Set A scores for the adults.

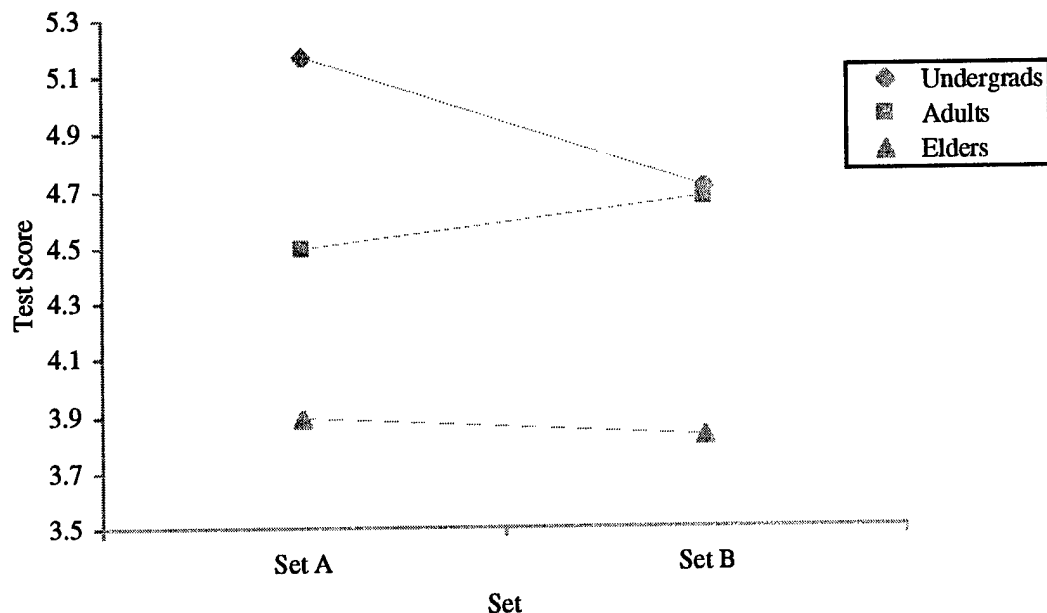


Figure 11. Cued recall interaction between Set and Participant Group.

Individual Instructions

A repeated measures ANOVA was performed using the scores from the eight drug information sheet instructions in order to assess differential recall for individual instructions. The ANOVA showed a significant difference in recall among the instructions, $F(7,1505) = 7.48, p < .0001$. Table 5 lists mean recall scores for each instruction in descending performance order. Post-hoc analysis of the means using Tukey's HSD test ($p < .05$) showed little difference between the instructions, with the top two (instruction 7 and 6) recalled significantly more often than the bottom two (instruction 3 and 2), with no other differences among the instructions. In general, unlike the free recall results, where Set A instructions tended to have higher mean scores

than Set B instructions, inspection of Table 5 shows a more balanced distribution of recall for Set A and B instructions.

Table 5

Cued Recall Means for Each Instruction

Instruction	Set	Description	Mean Score
7	A	Take until gone	1.25
6	B	Wash hands	1.19
8	B	Take with water	1.18
1	A	Not with milk	1.16
4	A	Not at bedtime	1.12
5	B	Don't break tablets	1.03
3	B	Not with other meds	0.99
2	A	Refrigerate	0.99

Incomplete Pictorials Omitted

Main effects. A 2 (Text: Present, Absent) x 2 (Pictorials: Present, Absent)

between-subjects ANOVA was performed which omitted scores from the Incomplete Pictorials conditions. The ANOVA showed a main effect of Text, $F(1,140) = 674.81$, $p < .0001$, with test scores higher when text was present ($M = 12.25$) than when text was absent ($M = 3.04$). There was also a main effect of Pictorials, $F(1, 140) = 59.58$, $p < .0001$, with test scores higher when pictorials were present ($M = 9.04$) than when they were absent ($M = 6.28$).

Interactions. The ANOVA also showed a significant two-factor interaction of Text and Pictorials, $F(1, 140) = 48.10, p < .0001$. This interaction can be seen by inspecting the means shown in Figure 12. The pattern of means show that omitting pictorials from the Pictorials Present/Text Present sheet had no effect on recall (from $M = 12.39$ to $M = 12.11$), yet omitting pictorials from the Pictorial Present/Text Absent sheet resulted in a significant drop in recall (from $M = 5.64$ to $M = 0.44$). Furthermore, omitting text from the Text Present/Pictorials Present sheet resulted in a significant drop in recall (from $M = 12.39$ to $M = 5.64$), yet not as great as drop as when text was omitted from the Text Present/Pictorials Absent sheet (from $M = 12.11$ to $M = 0.44$). This pattern was supported by Tukey's HSD test ($p < .05$).

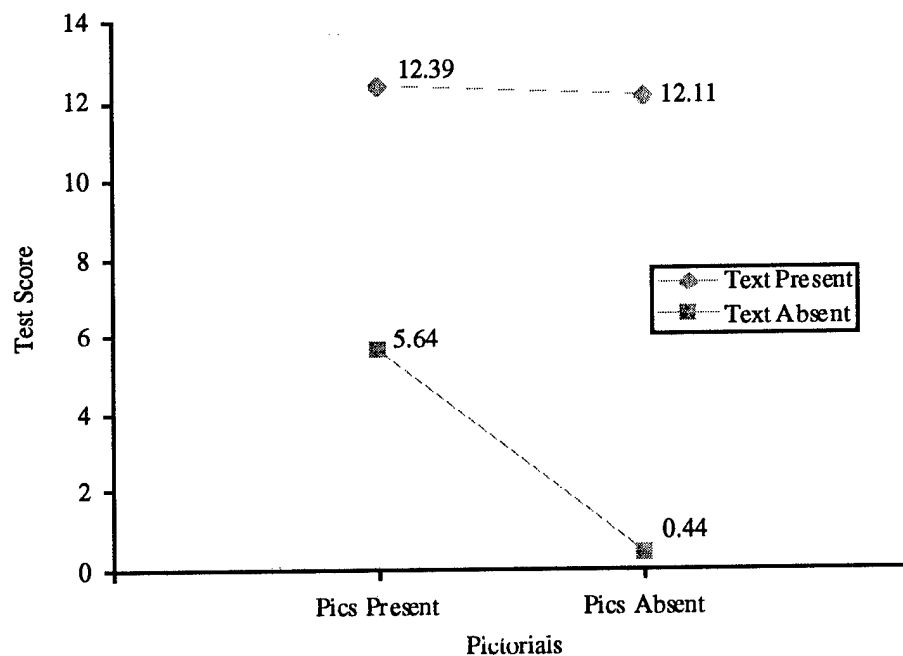


Figure 12. Cued recall interaction between text and pictorials.

Ratings

As discussed previously, for each of the six drug information sheets, participants answered the following question: "How effective is the drug information sheet at helping you understand and remember the medication instructions?" Likert scale ratings with the following anchors served as dependent variables: 1 = Not at all effective, 2 = Somewhat effective, 3 = Effective, 4 = Very effective, 5 = Extremely effective. Mean scores and standard deviations for Participant Group (Undergraduates, Adults, Elders) and Sheet Format (Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials 1, Incomplete Pictorials 2, Control) are listed in descending order in Table 6.

Table 6

Mean Ratings (SD) for Sheet Format and Participant Group

	Undergraduates	Adults	Elders	Total
Text & Pics	4.89 (.36)	4.71 (.54)	4.60 (.76)	4.73 (.59)
Inc. Pics 1	3.43 (.71)	3.07 (.81)	3.18 (.86)	3.23 (.81)
Inc. Pics 2	3.40 (.69)	3.04 (.78)	3.22 (.77)	3.22 (.76)
Text Alone	3.08 (.84)	2.83 (.75)	3.32 (1.02)	3.07 (.89)
Pics Alone	2.00 (.65)	2.06 (.93)	1.61 (.72)	1.90 (.80)
Control	1.01 (.12)	1.06 (.29)	1.06 (.37)	1.04 (.28)

Participant Group and Sheet Format

Main effects. A 3 (Participant Group: Undergraduates, Adults, Elders) x 6 (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials 1, Incomplete Pictorials 2, Control) mixed model ANOVA was performed. The ANOVA showed a significant main effect of Participant Group, $F(2,213) = 4.82$, $p < .01$, with Tukey's HSD test ($p < .05$) confirming that the Undergraduates provided higher ratings ($M = 2.97$) than either the Adults ($M = 2.79$) or the Elders ($M = 2.83$), with no difference between the Adults and Elders. The ANOVA also showed a significant main effect of Sheet Format, $F(5,1065) = 790.55$, $p < .0001$, with Text and Pictorials rated the highest ($M = 4.73$), followed in descending order by Incomplete Pictorials 1 ($M = 3.23$), Incomplete Pictorials 2 ($M = 3.22$), Text Alone ($M = 3.08$), Pictorials Alone ($M = 1.89$), and Control ($M = 1.04$). This pattern of means is depicted in Figure 13. Post-hoc analysis using Tukey's HSD test ($p < .05$) showed all formats to be significantly different from one another except between Text Alone and Incomplete Pictorials 1 and 2.

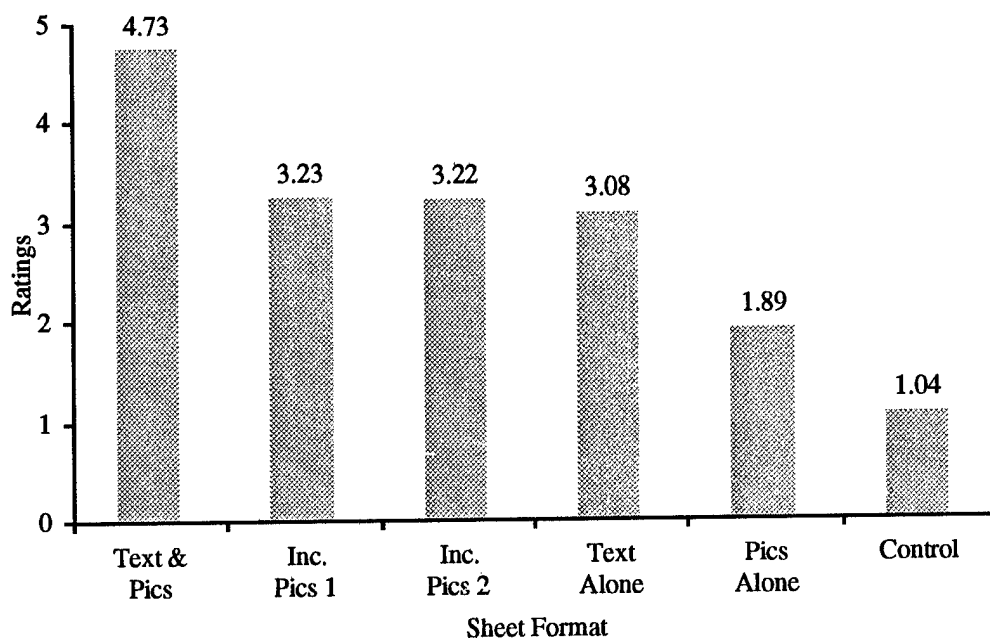


Figure 13. Ratings by Sheet Format.

Interaction. The ANOVA also showed a significant two-factor interaction of Participant Group and Sheet Format, $F(10,1065) = 5.07, p < .05$. This interaction can be seen by inspecting the means for the different sheet formats shown in Figure 14. The pattern of means show a consistent ratings pattern shared by all Participant Groups, with the exception of Text Alone, where Elders provided ratings which were significantly higher than the other groups, and Pictorials Alone, where the pattern reversed and Elders provided significantly lower ratings than the other two groups. This pattern was supported by Tukey's HSD test ($p < .05$).

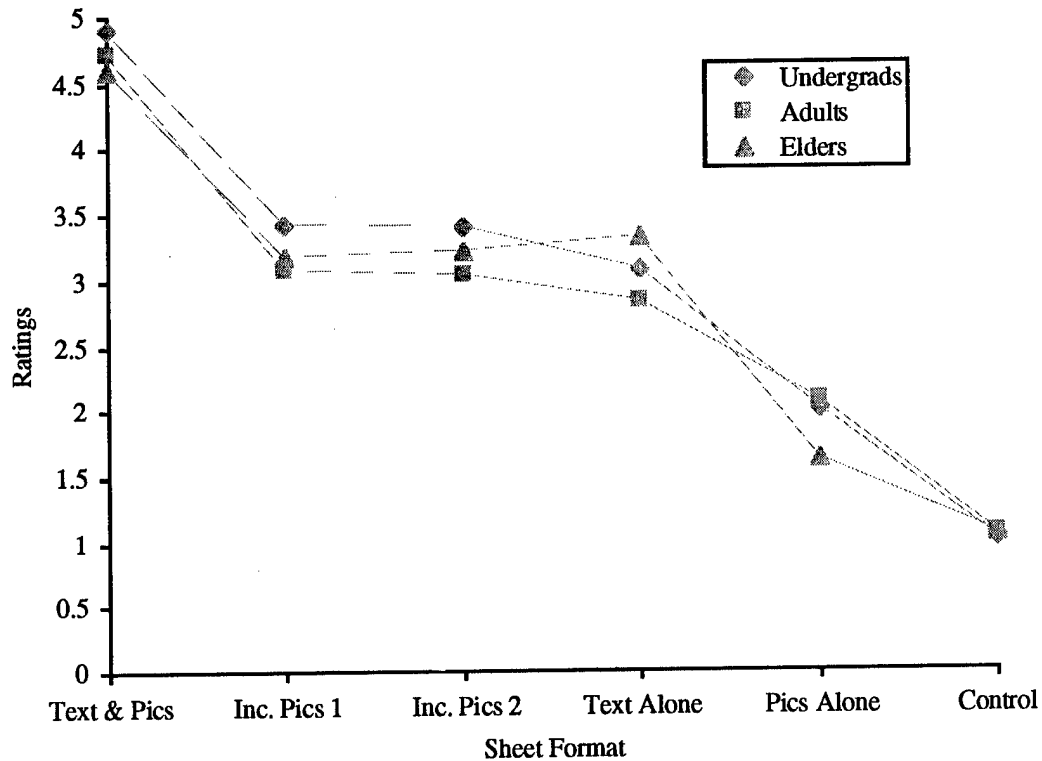


Figure 14. Interaction of Participant Group and Sheet Format.

First Exposure

Main effects. To determine whether recall testing had any effect on subjective ratings, a 6 (First Exposure: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials 1, Incomplete Pictorials 2, Control) x 6 (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials 1, Incomplete Pictorials 2, Control) mixed model ANOVA was performed, where First Exposure referred to the drug information sheet which was inspected and recalled. In addition to the main effect of Sheet Format discussed above, the ANOVA also showed a main

effect of First Exposure, $F(5,210) = 3.905$, $p < .05$. Post-hoc analysis using Tukey's HSD test ($p < .05$) showed that participants who were tested on the Pictorials Alone sheet provided higher overall ratings ($M = 3.04$) than participants who were tested on the other sheets (Text Alone: $M = 2.96$, Text & Pictorials: $M = 2.74$, Incomplete Pictorials 1: $M = 2.86$, Incomplete Pictorials 2: $M = 2.82$, Control; $M = 2.76$). In contrast, there were no differences among the ratings provided by participants exposed to the other sheets.

Interaction. The ANOVA also showed a significant two-factor interaction of Sheet Format and First Exposure $F(25,1050) = 1.60$, $p < .05$. While the interaction is difficult to depict graphically due to the large number of conditions, the concept is straightforward, and the means are listed in Table 6. When inspecting Sheet Format vs. First Exposure, the same general pattern of ratings were provided regardless of First Exposure (i.e., Text and Pictorials were rated highest, followed in descending order by Incomplete Pictorials 1, Incomplete Pictorials 2, Text Alone, Pictorials Alone, and Control, with no differences between Text Alone and Incomplete Pictorials 1 and 2), yet participants in two First Exposure conditions inflated the ratings given to their own sheets. Participants exposed to Pictorials Alone during recall testing rated their own sheet significantly higher than did the other participant groups. A similar effect occurred for Incomplete Pictorials 2. In general, all participants rated Incomplete Pictorials 1 and 2 equivalently, yet participants who were first exposed to Incomplete Pictorials 2 rated it significantly higher than Incomplete Pictorials 1. This pattern was supported by Tukey's HSD test ($p < .05$).

Table 7

Mean Ratings for Sheet Format by First Exposure

<u>First Exposure</u>	<u>Sheet Format</u>	<u>Ratings</u>
Text Alone	Text&Pics	4.81
	Inc. Pics 1	3.47
	Inc. Pics 2	3.39
	Text Alone	3.25
	Pics Alone	1.83
	Control	<u>1.00</u>
Pics Alone	Text&Pics	4.83
	Inc. Pics 1	3.39
	Inc. Pics 2	3.33
	Text Alone	3.28
	Pics Alone	2.31
	Control	<u>1.08</u>
Text&Pics	Text&Pics	4.75
	Inc. Pics 1	3.00
	Inc. Pics 2	2.89
	Text Alone	3.06
	Pics Alone	1.72
	Control	<u>1.00</u>
Inc. Pics 1	Text&Pics	4.78
	Inc. Pics 1	3.42
	Inc. Pics 2	3.33
	Text Alone	2.78
	Pics Alone	1.83
	Control	<u>1.03</u>
Inc. Pics 2	Text&Pics	4.67
	Inc. Pics 1	3.00
	Inc. Pics 2	3.25
	Text Alone	2.97
	Pics Alone	1.96
	Control	<u>1.11</u>
Control	Text&Pics	4.56
	Inc. Pics 1	3.09
	Inc. Pics 2	3.14
	Text Alone	3.08
	Pics Alone	1.69
	Control	<u>1.03</u>

Discussion

In this study, an attempt was made to evaluate the practice of communicating pharmaceutical information using various pictorial/text formats. Data were collected which may quantify the benefits and drawbacks inherent in presenting information using varying degrees of single or dual-coding. Participants examined drug information sheets which presented information in the following formats: text alone, pictorials alone, fully redundant text and pictorials, text with four instructions accompanied by pictorials (incomplete pictorials), and no instructions (control). To assess performance associated with each format, tests of comprehension and memory were administered, and subjective ratings were collected.

Comprehension and Memory

Free Recall vs. Cued Recall

While both the free recall and cued recall tests of comprehension and memory were administered and analyzed, it is clear that the free recall test was more descriptive, both in terms of statistical results, and generalizable application. With regard to statistics, while it was often the case that similar patterns of results were found using scores from both tests, it was also the case that some effects were found using the free recall test that did not exist with the cued recall test. In other words, the cued recall scores appeared less sensitive and powerful in detecting differences among conditions than did the free recall scores. The reason for this disparity (i.e., the preponderance of significant results when using free recall as compared to cued recall) becomes clear when comparing the free recall test means shown in Table 2 with the cued recall test means shown in Table 4. Inspection of the means show relatively elevated levels in

cued recall scores compared to free recall scores. It appears that using the cued recall test resulted in a near-ceiling effect, especially for the text alone, text and pictorials, and incomplete pictorials 1 & 2 formats, where participants performed at equally high levels. The resultant range reduction in means effectively reduced the robustness of the cued recall test.

In terms of generalizable application, the intent of this study was to apply a basic research paradigm involving recall of spatial and semantic information to a “real-world” scenario, where memory for pharmaceutical instructions has critical importance. In this application, a cued recall test which provides internal memory aids has less face validity than a free recall test which simply asks respondents to remember their medication instructions — a task similar to one confronted by hundreds of millions of people each day. Therefore, to reduce redundancy in discussing the results of the two tests (which for the most part were similar), while still seeking to draw conclusions that are both robust and generalizable, most of the following discussion will be limited to findings from the free recall portion of the Comprehension and Memory Test.

Fully redundant text and pictorials. The prevalent theme involving spatial and semantic presentation of information is the superiority in processing efficiency which results from redundantly coded information (Booher, 1975; Edworthy & Austin, 1996; Levin & Lesgold, 1978). Such superiority was evident in this study, where comprehension and recall of pharmaceutical information was facilitated by the use of fully redundant text and pictorials. Across a wide variety of ages and participant backgrounds, information presented in both a spatial and semantic form was recalled consistently more often than other combinations of information. Paivio’s (1975) Dual

Code Theory and Wickens' (1982) Redundant Code Theory clearly apply to the presentation of medication dosing instructions.

Incomplete dual coding. Conclusions drawn from instances of incomplete dual coding are not so clear. Using an incomplete set of pictorials was predicted to be detrimental to overall performance when compared to text alone instructions. That prediction was based on the belief that incomplete pictorial sheet instructions which did not have pictorials would fail to capture attention (see Laughery et al., 1993; Schmidt & Kysor, 1987), and would be less efficiently processed (see Glenberg & Langston, 1992; Wiseman et al., 1985) than instructions on the same sheet that were accompanied by pictorials. In either case, the instructions from the incomplete pictorials sheets which did not have pictorials should have been associated with poor recall. In addition, the incomplete pictorial sheet instructions which did not have pictorials should have failed to capture attention (and been less efficiently processed) than the same instructions on the text alone sheet (which were not competing for attention with pictorial instructions). This once again should have resulted in poor recall performance for instructions on the incomplete pictorials sheets which did not have accompanying pictorials.

None of the above hypotheses were supported. When comparing recall across information sheets, test scores from the incomplete pictorials sheets were just as high as scores from the text alone sheet. When examining the effect of Set, there were no differences between the incomplete pictorials sheet instructions accompanied by pictorials and the instructions on the same sheets that were unaccompanied by pictorials. Finally, there were no differences in textual Set instructions from the incomplete pictorials sheets and the same textual Set instructions from the text alone sheet. In

essence it seems as though comprehension and memory were unaffected by the detrimental premises of incomplete dual coding. As a consequence, it appears as if an instruction sheet which contained text and some number of pictorials was just as effective as an instruction sheet presented entirely as text.

To understand why the hypotheses were not supported, further examination into the recall of the individual instructions is needed. When examining the recall means associated with each individual instruction (Table 3), it is apparent that some instructions were retained much more readily than other instructions, regardless of the presentation format used to present the information. For instance, the instruction "Take with a glass of water" was recalled twice as often as the instruction "Store in the refrigerator." While the reason for the difference in recall among the instructions is unclear, it is believed here that familiarity played a significant role in determining which instructions were readily recalled, and which instructions were not. Perhaps the highly-recalled instructions (e.g., "Take with water," "Do not take at bedtime," and "Take until gone") are more commonly prescribed, and are therefore more familiar to most participants. When participants read those instructions, prior experience was readily used as a memory aid, with later recall being correspondingly high. In contrast, the poorly-recalled instructions (e.g., "Store in refrigerator," "Do not take with other medications," and "Don't break or crush tablets") are seemingly less common instructions, thereby providing participants with less experiential schema to draw upon when confronted with the free recall test. Therefore, encoding and subsequent retrieval of the less-familiar instructions might have been more difficult.

While it was expected that some instructions would be more readily recalled

than other instructions, the problem here arose when an inordinate distribution of highly-recalled instructions were assigned to Set A, with the correspondingly disproportionate number of poorly-recalled instructions assigned to Set B. Since the assignment of instructions to Sets A and B was made at random (without prior knowledge into which instructions would be recalled the most), the expectation was that there would be no difference in recall between equivalently-coded Set A and Set B instructions. In other words, within the text alone, pictorials alone, text and pictorials, and control formats, Set A instructions should have been recalled equally as often as Set B instructions. However, this was not the case, and collapsed across conditions, Set A instructions were remembered significantly more often than Set B instructions. Inspection of Table 3 shows that three of the four highly-recalled instructions belonged to Set A, while three of the four poorly-recalled instructions belonged to Set B. Having this disparity in recall among the instructions coincide with the assignment of instructions to Sets A and B (heretofore known as the "Set A Superiority Effect") made the experimental groups unequal, even before manipulation of the independent variables.

Unfortunately, the Set A Superiority Effect may have been responsible for the null results involving the incomplete pictorials conditions. It appears that Set A instructions were so readily recalled that it mattered little if those instructions were accompanied by pictorials or not. In other words, the Set A Superiority Effect may have overshadowed any of the expected differences between the incomplete pictorials instructions. For example, it was hypothesized that Set A instructions from Incomplete Pictorials 1 (text instructions accompanied by pictorials) would be recalled more often than Set B instructions from the same sheet (text instructions unaccompanied by

pictorials). While this was found to be the case, it is unclear whether the difference can be attributed to the pictorials in Set A, or the highly-recalled instructions that comprised Set A. Similarly, it was hypothesized that Set A instructions from Incomplete Pictorials 2 (text instructions unaccompanied by pictorials) would not be recalled as well as the same Set A instructions from the text alone sheet. This effect was not found, and may have been because the Set A Superiority Effect served to elevate recall of the Set A instructions on the text alone sheet.

In either of the above cases (and other situations involving comparisons between Set instructions), the high levels of recall associated with Set A make conclusions stemming from the application of incomplete pictorials problematic. In the worst case, as has been stated already, there were no expected differences between the incomplete pictorials sheets and the text alone sheet. At best, it can be said that differences may still exist, but cannot be reliably determined because of the disparity in "equal" composition of the instruction sets. Given this latter scenario, a positive trend was found when examining the means in Figure 6. Inspection of the figure shows that Set A instructions were recalled more often than Set B instructions for every sheet format **except** Incomplete Pictorials 2. In this once instance, the use of pictorials may have counteracted the Set A Superiority Effect, resulting in Set B instructions (those accompanied by pictorials) being recalled more often (yet not significantly) than Set A instructions (those unaccompanied by pictorials).

Single coding. As predicted, recall of the text alone instructions was not as high as the fully redundant text and pictorials instructions, demonstrating the D'Agostino et al. (1977) finding that use of a single semantic code was not as efficient as the use of a

redundant dual code. And while the text alone instructions were not recalled any better than the incomplete pictorials instructions, the use of text alone was still advantageous over the use of pictorials alone and no instructions (control). Inspection of Figure 7 confirms that text is the critical component in the text-pictorial coding system. While the use of communication formats which omitted pictorials caused slight decreases in recall performance, using formats which omitted text produced a dramatic (and seemingly catastrophic) drop in performance. The pictorials alone format was consistently associated with low recall, with scores only higher than that of the control format. As mentioned previously, numerous researchers (e.g., Collins et al., 1982; Dewar, 1994) believe that pictorials should rarely be used as a sole communication source. Even when pictorials were chosen which had acceptable rates of comprehension (recall that the pictorials used here all met ANSI's 85% comprehension criteria), when used alone the pictorials did not convey the level of detail needed for proper comprehension of the pharmaceutical information.

Control. The use of the no instruction (control) format enabled a demonstration of participants' base line medication-instruction knowledge without benefit of any instructions other than those printed on the medication bottle label. The lack of any correct responses associated with the control format serves as proof that participants exposed to the other formats were not simply recalling common medication instructions from previous experience, but rather were remembering instructions that were presented on the drug information sheets. It appears that some information in addition to that which is simply provided on a drug bottle label can stimulate memory for important dosing instructions. This suggests that some form of additional instructions (beyond

those normally found on basic prescription drug bottle labels) should be provided to consumers in order to assure compliance with all proper dosing procedures.

Age. Due to the applied nature of this research, a diverse participant group was selected, and the effects of age on memory for medication instructions was of particular interest. As mentioned previously, there was a unique requirement to include older adults (Elders) as one participant group, since they tend to consume more medications than other population groups, and because declining visual and cognitive difficulties may decrease their ability to read and understand pharmaceutical instructions.

As expected, an age-related loss in recall was exhibited. Undergraduates consistently had the highest recall scores, followed by the adults, with the elderly participants exhibiting the poorest recall. In fact, the older adults only recalled approximately 50% of the information recalled by the undergraduates. And since they self-medicate so frequently (relative to other groups), the conclusion that older adults have difficulty comprehending and remembering common medication instructions is critically important. This finding is consistent with previous research (e.g., Morrell et al., 1989; Morrow, et al, 1995; Park and Halter, in press) showing that older adults have greater difficulty remembering medication information and adhering to dosing schedules. Clearly this is the target population that must be addressed when developing methods of improving memory for pharmaceutical instructions. In this regard, drug information sheets like the ones used here were effective, and all participants (including the older adults), benefited from examining some form of information. A key research direction involves improving older adults' recall to a level consistent with that exhibited by much younger adults.

Instruction composition. The fact that the instruction directive was recalled significantly more often than the instruction explanation was enlightening. This finding was expected for the pictorials alone format since, as mentioned previously, the pictorials did not specifically address the level of detail required to fully understand the explanation portion of an instruction. For example, the picture of a medicine being stored in the refrigerator did not convey "why" the medicine should be stored there, and the proper reason had to be inferred. On the other hand, when text information was provided, the reason "why" - that refrigeration extends the shelf life of the medicine, required only proper recall, not inference. Indeed, for the participants who viewed the pictorials alone format, recall performance for the explanation portion of the instructions fell almost to zero, demonstrating participants' inability (or unwillingness) to make the proper inferences into "why" an instruction was given.

The more interesting finding involving directives vs. explanations is that even the participants exposed to the information sheets other than the pictorials alone format recalled the explanations at a much lower rate than the directives. Speculation into the reason for this finding takes one of two forms. First of all, the participants may have tried to memorize all of the medication information, but found the directives much easier to remember than the explanations. This may have occurred because of the interference that inevitably occurred as the participants attempted to memorize and then recall 16 different instructional statements. In this case, the directives, being more concrete and action-oriented, may have been more easily retrieved than the more abstract explanations. Secondly, the participants may have actively chosen to concentrate on rehearsing and memorizing the directives, at the expense of the explanations. When

confronted with memorizing a page of information, perhaps participants chose a strategy that focused on the instruction aspect they deemed most critical. In cases involving medication dosing, the most critical information would seem to be the instruction directive - what the individual should or should not do. As such, the instruction explanation might have been seen as supplementary information, or information that was merely "nice to know."

In either case, the fact that instruction directives were recalled at a much higher rate than instruction explanations is an important finding, and one that might be critical when designing future medication instructional materials. Knowing that directives are more readily recalled than explanations might serve to guide the investment of design effort. Certainly the directive portion of an instruction requires proper design emphasis. However, in cases where the explanation portion of an instruction is especially critical, thereby requiring increased attention and recall, substantial effort may be needed to facilitate recall of that information. It is interesting to note that there is a growing trend in all warnings research to include more elaborate explanations (e.g., more detailed consequences statements) when presenting warnings, which may in turn help motivate people to comply (Wogalter & Laughery, 1996).

Cued recall test. As discussed previously, the findings from the cued recall test were similar in most respects to the free recall results discussed above. Once again, the main findings of interest remained consistent: (1) information from the redundant text and pictorials format was recalled more often than information from the other formats (though not significantly more than text alone or incomplete pictorials); (2) recall of information from the pictorials alone and control formats was very poor; (3) text was

more critical to recall than were pictorials; (4) instruction directives were recalled significantly more often than instruction explanations; and (5) older adults recalled significantly less information than the other two groups.

In general, the higher cued recall test scores and associated range reduction in means nullified the differences between the text and pictorials, text alone, and incomplete pictorials formats, as well as the differences in Set A and Set B recall.

Ratings

As predicted, the fully dual-coded text and pictorials information sheet received the highest ratings, demonstrating the Kalsher et al. (1996) finding of subjective preference for combined text/pictorial information. Participants appeared to appreciate the redundant presentation technique, and may have believed that text and associated pictorials would effectively facilitate understanding and recall of the medication instructions. In this regard, Paivio's (1975) Dual Code Theory and Wickens' (1982) Redundant Code Theory seem to apply to subjective beliefs as well as objective measures.

Consistent with expectations and previous research (e.g., Sojourner & Wogalter, 1996), the incomplete pictorials sheets were rated the next highest in terms of subjective preference. Of some surprise was the fact that the incomplete pictorials sheets received the same ratings as the sheet using text alone. Apparently participants believed that communicating with only a partial set of pictorials to accompany textual information was just as effective as communicating with text used alone. Since the ratings effectively mirrored the results found during comprehension and memory testing, a strong case can be made for the interchangeable nature of either incomplete pictorials or

text alone. Not only were there no differences in recall between the two formats, participants also perceived there would be no difference between them. This may have far reaching implications for the designers, distributors, and users of drug information sheets. When confronted with an incomplete set of pictorials, apparently it may not always be a foregone conclusion that the pictorials are completely necessary.

As for the pictorials alone and control formats, results mirrored expectations. When pictorials were used alone, participants deemed them as being only somewhat effective. Once again, consistent with the recommendations made in the literature (e.g., Collins et al., 1982; Dewar, 1994), pictorials should not be used as a sole communication method. As for the no instruction format, participants believed that a simple drug name and purpose statement were completely ineffective at aiding comprehension and memory. When compared to the ratings assigned to the other drug information sheets, it appears that participants believe medication information supplied in any format is superior to no information at all. The desire to be supplied with supplemental written medication information is consistent with recommendations made by Morris and Halperin (1979).

Age. While the same general pattern of ratings were provided by all age groups, the older participants did have stronger opinions regarding the single-coded instructions. Consequently, the older adults rated the text alone sheet higher than did the other two participant groups, while rating the pictorials alone sheet lower than the other participant groups.

For two reasons, this finding might be expected when one considers the experience base enjoyed by the older participants. First of all, as stated earlier, older

adults generally take more medications than do other population groups. Furthermore, this increased experience leads to greater familiarity with drug information communication methods (e.g., drug information sheets). However, it is also true that the communication methods used today rarely employ the use of pictorials, relying instead on printed verbal messages. Consequently, it is not surprising that older adults might provide a higher rating for textual instructions, since they repeatedly use textual medication information on a day to day basis. Secondly, much like the assumption that older adults have had greater experiences with medication information, it might also be assumed that older adults have had less experience with pictorials (icons) in general. In fact, while many of the undergraduate and young adult participants anecdotally reported seeing similar pictorials to the ones used here on various warnings, signs, and computer applications, rarely did older adults report the same types of experiences. Since the use of pictorials has proliferated in recent years, especially in the area of safety signage and computer applications, it once again is not surprising that older adults would rate them as less effective. This belief may merely reflect a greater unfamiliarity with pictorials in general.

Comprehension and memory carryover effects. While the type of drug information sheet participants were exposed to during comprehension and memory testing had little effect on subjective ratings, some qualification is required. First of all, participants tested on the pictorials alone sheet later provided higher overall ratings for all sheets (compared to all other participants). The explanation for this becomes clear when considering that when used alone during comprehension and memory testing, the pictorials provided only limited information. Subsequently, when all of the drug

information sheets were presented during the ratings phase, those participants that had been tested on the pictorials alone sheet may have inflated all other ratings when they realized that other sheets were available which provided a greater amount of information. In essence, the other sheets compared quite favorably to the information-deprived pictorials alone sheet, thereby resulting in a type of boomerang effect, where all sheets were subsequently assigned particularly high ratings. Another instance of comprehension and memory testing affecting ratings results occurred as participants exposed to two of the sheet formats inflated the ratings given to their own sheet. Such was the case with the participants exposed to the pictorials alone sheet, who in turn rated their own sheet higher than did the other participants. A similar ratings inflation was witnessed by the participants exposed to Incomplete Pictorials 2, who rated their own sheet higher than Incomplete Pictorials 1 (a finding unique to that particular group). While it is apparent that these two groups found their own comprehension and memory sheet to be particularly effective in terms of ratings, it is most important to note that the same general pattern of ratings was provided by all groups, regardless of testing exposure.

Conclusion and Implications

Fully redundant medication instructions which presented information in both a semantic (textual) and spatial (pictorial) format were preferred over other presentation techniques. Both in terms of objective recall performance and subjective preference ratings, the results associated with dual-coded instructions far surpassed those associated with other combinations of information. As Wickens (1992, pg. 193) stated, "the performance advantage attributed to the redundancy of information stands as one

of the more firmly validated concepts in the engineering psychology of instructions.” Clearly this performance advantage applies to medication instructions, and the use of redundant pictorials and text should be undertaken in the future whenever possible.

However, as is the case in many pharmaceutical settings, representing information using fully redundant text and pictorials is not always possible or feasible. It was originally hypothesized here that the use of incomplete pictorials would be detrimental to performance, and that text alone should therefore be used when full redundancy is impossible. Research findings from this study do not support this hypothesis, however, and it appears that incomplete pictorials were just as effective (and preferred) as text used alone. While the position is taken that the null findings involving incomplete pictorials and text alone were methodological in nature, the results of this study clearly show no difference between the two presentation methods.

One recommendation that is clear involves the use of pictorials as the sole method of communicating pharmaceutical information. Consistent with recommended guidelines, pictorials used alone should rarely be used as a substitute for textual instructions. It appears as though the amount of information that can reliably be gleaned from a pictorial is limited, and while their use may still be beneficial when compared to no instructions at all, pictorials should only be used to augment existing text.

A further recommendation concerns the no instruction (control) condition. The fact that participants exposed to the control format scored zero on the free recall test appears to be persuasive evidence that consumers need supplemental medication instructions to aid comprehension and recall of dosing information. To maximize effectiveness, the supplemental information should be both legible and understandable.

A final comment which addresses the use of older adults as participants is warranted. As stated earlier, older adults are an important target population when researching medication recall and adherence. Communicating medication information to older adults is a unique challenge since they tend to take more medications than other groups, while at the same time are experiencing the physical and cognitive declines which accompany the aging process. Taken as a whole, older adults in this study behaved much like the other participants, with the only difference being that the older adults recalled far less information. Unfortunately, recalling "far less information" often translated into very poor memory performance. This fact points to the critical need to improve methods of disseminating medical information in a manner which promotes proper recall and safe behavior for elderly individuals.

Future research. While this study effectively answered many research questions, still others remain for future endeavors. First of all, the research hypotheses involving the drawbacks of incomplete dual coding were not supported. However, basic theory involving attention allocation and processing efficiency point to the fact that the use of incomplete pictorials should be detrimental. Future research which presents different medication instructions using other pictorials in varying presentation orders is needed to substantiate that conclusion. Secondly, the applied nature of this medication research requires a more applied research setting. Instead of an artificial laboratory setting which imposes a time limit for review of the drug information sheets, a more realistic environment using actual pharmaceutical purchases and dosing behavior is suggested. Finally, an area desperately in need of additional study involves the use of participants who are unable to read printed verbal messages. Perhaps the strongest

support for the use of pictorials comes from the need to communicate with non-English speakers, the illiterate, or those whose vision deficiencies preclude them from reading printed verbal messages. While a comprehensive study using those individuals as the target population would be difficult (perhaps the reason why it has not yet been undertaken), it is a research area that needs to be explored.

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Appendices

Appendix A

Drug Information Sheets

- 1) Text Alone
- 2) Pictorials Alone
- 3) Text and Pictorials
- 4) Incomplete Pictorials 1
- 5) Incomplete Pictorials 2
- 6) Control

FLORONEX HCT

Inhibits the parasympathetic nervous system and induces dilation of peripheral blood vessels

Do not take with milk or other dairy products. Dairy products interfere with absorption of this medication.

The shelf life of this medication will be extended if stored at temperatures less than 50 degrees. Store in refrigerator.

Do not take other medicines with this medicine. This medicine reacts negatively with numerous other drugs.

This medication may cause unrest and sleeplessness. Do not take at bedtime.

This medication has been precisely measured, and it is important that each tablet be taken in whole form. Do not break or crush tablets or caplets.

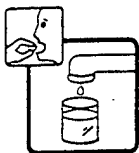
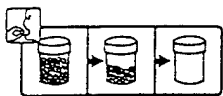
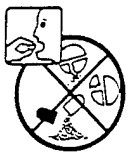
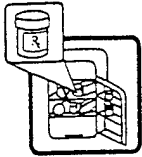
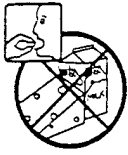
Wash hands. This medication is readily absorbed through the skin, and hands should be washed immediately after taking the medicine.

Take until gone. Even though disease symptoms may disappear in a few days, all of this medication must be taken to avoid disease recurrence.

This medication may cause dehydration. Take with a glass of water.

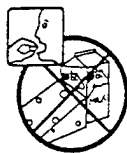
FLORONEX HCT

Inhibits the parasympathetic nervous system and induces dilation of peripheral blood vessels



FLORONEX HCT

Inhibits the parasympathetic nervous system and induces dilation of peripheral blood vessels



Do not take with milk or other dairy products. Dairy products interfere with absorption of this medication.

The shelf life of this medication will be extended if stored at temperatures less than 50 degrees. Store in refrigerator.



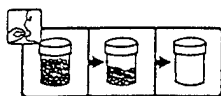
Do not take other medicines with this medicine. This medicine reacts negatively with numerous other drugs.



This medication may cause unrest and sleeplessness. Do not take at bedtime.

This medication has been precisely measured, and it is important that each tablet be taken in whole form. Do not break or crush tablets or caplets.

Wash hands. This medication is readily absorbed through the skin, and hands should be washed immediately after taking the medicine.



Take until gone. Even though disease symptoms may disappear in a few days, all of this medication must be taken to avoid disease recurrence.

This medication may cause dehydration. Take with a glass of water.

FLORONEX HCT

Inhibits the parasympathetic nervous system and induces dilation of peripheral blood vessels

Do not take with milk or other dairy products. Dairy products interfere with absorption of this medication.



The shelf life of this medication will be extended if stored at temperatures less than 50 degrees. Store in refrigerator.

Do not take other medicines with this medicine. This medicine reacts negatively with numerous other drugs.

This medication may cause unrest and sleeplessness. Do not take at bedtime.

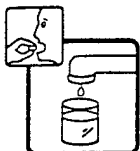


This medication has been precisely measured, and it is important that each tablet be taken in whole form. Do not break or crush tablets or caplets.



Wash hands. This medication is readily absorbed through the skin, and hands should be washed immediately after taking the medicine.

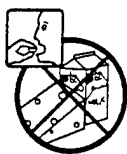
Take until gone. Even though disease symptoms may disappear in a few days, all of this medication must be taken to avoid disease recurrence.



This medication may cause dehydration. Take with a glass of water.

FLORONEX HCT

Inhibits the parasympathetic nervous system and induces dilation of peripheral blood vessels



Do not take with milk or other dairy products. Dairy products interfere with absorption of this medication.



The shelf life of this medication will be extended if stored at temperatures less than 50 degrees. Store in refrigerator.



Do not take other medicines with this medicine. This medicine reacts negatively with numerous other drugs.



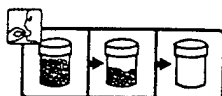
This medication may cause unrest and sleeplessness. Do not take at bedtime.



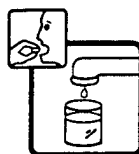
This medication has been precisely measured, and it is important that each tablet be taken in whole form. Do not break or crush tablets or caplets.



Wash hands. This medication is readily absorbed through the skin, and hands should be washed immediately after taking the medicine.



Take until gone. Even though disease symptoms may disappear in a few days, all of this medication must be taken to avoid disease recurrence.



This medication may cause dehydration. Take with a glass of water.

FLORONEX HCT

Inhibits the parasympathetic nervous system and induces dilation of peripheral blood vessels

Appendix B

Medication Bottle Label

KERR DRUGS
1432 CAPITAL BLVD
RALEIGH, NC 27604
(919) 266-6110

RX 567489 DR JAMES SMILEY

TAKE ONE TABLET
THREE TIMES PER DAY

FLORENEX HCT 60 MG TABLETS
QUANTITY: 40 TABLETS
NO REFILLS
EXPIRES 08/20/97

Appendix C

Consent Form

**INFORMED CONSENT FOR HUMAN
PARTICIPANTS IN A RESEARCH PROJECT**

Project Title: The influence of presentation format on the comprehension of pharmaceutical information

Principle Investigator: Michael S. Wogalter Ph.D., Associate Professor of Psychology, Phone: (919) 515-1726

I voluntarily agree to participate in this study. I understand that I can terminate my participation at any point without penalty and without jeopardy.

The experiment has been described to me by the investigator, who has answered all my questions. I understand that I will be asked to evaluate several different methods used to communicate information about a pharmaceutical product. I also understand that if I have any further questions I can contact Dr. Wogalter at the number listed above.

In addition, I understand the following:

1. Adequate safeguards will be taken to maintain privacy, and my responses will be kept confidential at all times.
2. My name will not be attached to any surveys. Code numbers/letters will be used.
3. Individual responses will not be reported. The information collected in this study will be aggregated into group scores, and reported only as averages across many participants.

(participant's signature)

(date)

Appendix D

Demographics Questionnaire

1. What is your gender? ☐ Male ☐ Female

2. What is your age? years old

3. What is your occupation?

4. What is the highest level of education that you have finished? (check one)

- ☐ Elementary school
- ☐ Middle school/junior high
- ☐ Some high school
- ☐ High school graduate
- ☐ Some college
- ☐ College graduate
- ☐ Some graduate school
- ☐ Masters Degree
- ☐ Ph.D. or MD or other doctoral degree

5. What is your ethnic/racial background? (check one)

- ☐ African-American
- ☐ Asian
- ☐ Caucasian
- ☐ European
- ☐ Hispanic
- ☐ Middle Eastern
- ☐ Native-American
- ☐ Pacific Islander
- ☐ Multi-racial (please specify) _____
- ☐ Other (please specify) _____

6. Have you ever had trouble reading or understanding a prescription drug bottle label?

☐ Yes ☐ No

If "yes," what kind of trouble?

7. Have you ever wished you had more information about a particular drug?

☐ Yes ☐ No

If "yes," what kind of information?

8. Have you ever attempted to call the 1-800 phone number listed on the drug bottle label in order to receive additional information? ☐ Yes ☐ No

9. Have you ever forgotten important information about a particular prescription drug?
☐ Yes ☐ No

10. If "yes" to question 9, did you remember the information later on?
☐ Yes ☐ No

11. When obtaining a prescribed drug, has a pharmacist/assistant ever provided you with any medication information beyond that which was printed on the drug bottle label?
☐ Yes ☐ No

If "Yes," please specify the form of the additional information given (check all that apply):

☐ Verbal instructions (counseling)

☐ Information sheet or pamphlet

☐ Other (please specify) _____

12. How frequently has a pharmacist/assistant volunteered to provide you with additional information?

☐ Never ☐ Seldom ☐ Occasionally ☐ Frequently ☐ Always

13. Have you ever had trouble reading or understanding the additional information provided by the pharmacist/assistant? ☐ Yes ☐ No ☐ Not Applicable

If "yes," what kind of trouble?

14. If you were deciding what information to place on a medication container label, think about the information that would be most important. Using the scale below, please assign an importance rating from 1 - 5 to each of the following items (please read through the entire list before answering):

1	2	3	4	5
Not at all Important	Somewhat Important	Medium Importance	Very Important	Extremely Important

- ___ Consumer's name
- ___ Doctor's name
- ___ Pharmacist's name
- ___ Pharmacy name
- ___ Consumer's address and telephone number
- ___ Pharmacy address and telephone number
- ___ Drug name
- ___ Dosage information
- ___ Hazards and warnings associated with the drug
- ___ Quantity of pills
- ___ Number of refills allowed
- ___ Expiration date
- ___ Other (please specify): _____

15. Have you ever held a job that involved the production or sale of medications?
 ___ Yes ___ No

If "yes," please explain:

Appendix E

Comprehension and Memory Test

List as much of the information contained on the Drug Information Sheet as possible. Please be as thorough and complete as you can:

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

Using the spaces provided, answer each question as completely as possible:

1. When is it okay to take other medicines with this medicine? Please explain.
2. What liquid should be used to take the medicine? Why?
3. Where should the medicine be stored? Why?
4. At what time of day should you **NOT** take the medicine? Why?
5. Should you take the medicine with milk? Why or why not?
6. When taking the medication, when should your hands be washed? Why?
7. When is it okay to break the tablets in half? Please explain.
8. For how long should you take the medicine? Why?

Appendix F

Ratings Form

Instructions:

Using the five-point scale shown below, answer the following question by assigning a rating from 1 to 5 to each of the Drug Information Sheets. You may assign the same rating to more than one sheet.

Question:

“How effective is the Drug Information Sheet at helping you understand and remember the medication instructions?”

Scale:

1	2	3	4	5
Not at all Effective	Somewhat Effective	Effective	Very Effective	Extremely Effective

Ratings:

_____ Drug Information Sheet A

_____ Drug Information Sheet B

_____ Drug Information Sheet C

_____ Drug Information Sheet D

_____ Drug Information Sheet E

_____ Drug Information Sheet F

Appendix G

Instructions to Participants

General Introduction:

Today you will be asked to evaluate a number of different methods of presenting medication information. The information gathered here will be used to determine the most effective way to present prescription medication instructions. We are collecting information on people's impression and understanding of different instructional formats. We appreciate your participation, because your opinions could be very valuable in helping to design better pharmaceutical products. Do you have any questions at this time? (*have them read and sign consent form*).

Introduction to the study:

To set the stage for the study, I would like you to pretend that you've just left your doctor's office. Although your visit to the doctor was for a routine physical, tests revealed that you have a serious illness. While the illness can be treated with medication, the diagnosis came entirely out of the blue, and frankly, you are a little nervous and anxious about the illness, and the medication prescribed to treat it. You are unfamiliar with the drug your doctor prescribed, and have now come to your local pharmacy to get the prescription filled. You will be receiving a filled medication bottle, and a drug information sheet. Each will contain various instructions regarding proper use of your medication. After reviewing the label on the bottle and the drug information sheet, you will be asked various questions about the information presented to you. Do you have any questions at this time?

Procedures:

Label and sheet: (*Hand them the drug bottle*). Here is your medication. Please take just a few moments to review the information on the label. (*pause briefly*). I'm now going to give you a drug information sheet that provides you with additional information and instructions about the drug. You will have **60 seconds** to examine the

information on the sheet. Due to the limited amount of time, you must **quickly** examine and familiarize yourself with the information on the sheet. (*hand them the sheet, keep time, and collect*).

Questionnaire: Now we'll begin the evaluation portion of the study. To aid the evaluation, I would first like you to answer some questions about yourself and your opinions regarding prescription medications. I have a short questionnaire for you to complete. (*hand them the questionnaire*). Take as much time as you need, and let me know when you are finished. (*collect questionnaire*).

Medication Questionnaire: Now I would like you to complete a questionnaire concerning the medication. Questions relate specifically to the information presented on the Drug Information Sheet which you examined earlier. Using the information that was presented on the sheet, and any prior knowledge or information you may have, please answer the questions as thoroughly and completely as possible. If you don't know the answer to a question, just leave that question blank.

(*hold up the questionnaire*). This is a two page questionnaire. After completing page one, move on to page two, and please do not return to the first page to change or add any answers. There is no time limit, so take as much time as you need. Do you have any questions? (*hand them the questionnaire*).

Ratings: The last thing I would like you to do is give me your **opinion** regarding the drug information sheet. This is the drug information sheet you examined earlier. (*lay the original sheet on the table*). We are comparing this one with other drug information sheets that present information in slightly different ways. (*lay out each of the other sheets, with associated sheet label cards*). Please take a few minutes to examine and familiarize yourself with each of the different sheet formats. You don't need to concern yourself with the content of the information on the sheets, but rather pay attention to the **way** the information is presented on the different sheets. After you examine all of the sheets, I would like you to rate each one using a scale provided on this rating form. (*show them the form*). You simply need to answer one question, and

by using the five point rating scale, give a single numerical rating to each drug information sheet. You don't need to use all the numbers, and you may use a number more than once. (*hand them the ratings questionnaire*). Do you have any questions?

Debrief:

Your participation in this study has been extremely helpful to human factors psychologists investigating the methods of presenting medication information to the general public. We hope to someday influence the manner in which the pharmaceutical industry presents prescription medication information. Your participation has been very helpful. Thank you very much.

Appendix H

Comprehension and Memory Test Item Analysis Using 36 Pilot Participants

<u>Number</u>	<u>Sheet Format</u>	<u>% Correct</u>
1	Text and Pics	75
2	Text and Pics	75
3	Text and Pics	88
4	Text and Pics	88
5	Text and Pics	88
6	Text and Pics	88
7	Inc. Pics 2	50
8	Inc. Pics 2	63
9	Inc. Pics 2	88
10	Inc. Pics 2	88
11	Inc. Pics 2	88
12	Inc. Pics 2	88
13	Inc. Pics 1	38
14	Inc. Pics 1	63
15	Inc. Pics 1	63
16	Inc. Pics 1	75
17	Inc. Pics 1	75
18	Inc. Pics 1	100
19	Text Alone	50
20	Text Alone	50
21	Text Alone	63
22	Text Alone	75
23	Text Alone	75
24	Text Alone	88
25	Pics Alone	0
26	Pics Alone	0
27	Pics Alone	13
28	Pics Alone	13
29	Pics Alone	25
30	Pics Alone	25
31	Control	13
32	Control	0
33	Control	0
34	Control	0
35	Control	0
36	Control	0

<u>Score</u>	<u>Frequency</u>	<u>Percent</u>	<u>Cum. Freq.</u>	<u>Cum. %</u>
0	7	19.4	7	19.4
1	3	8.3	10	27.8
2	2	5.6	12	33.3
3	1	2.8	13	36.1
4	3	8.3	16	44.4
5	4	11.1	20	55.6
6	6	16.7	26	72.2
7	9	25.0	35	97.2
8	1	2.8	36	100.0

<u>Question Number</u>	<u>Point Biserial</u>	<u>Question Number</u>	<u>Discrim. Index</u>	<u>Question Number</u>	<u>Difficulty Level</u>
4	.5713	3	.7778	1	.4167
1	.6043	5	.7778	2	.4722
5	.6256	8	.7778	4	.4722
8	.6455	1	.8889	3	.5000
2	.6910	2	.8889	5	.5278
3	.7071	4	.8889	8	.5278
6	.7957	6	.8889	7	.5556
7	.8462	7	1.000	6	.6667

Mean Test Score = 4.1389
 Standard Deviation = 2.7893
 Kuder-Richardson = 0.7482

Appendix I
ANOVA Tables 1-12

ANOVA Table 1

Free Recall: Incomplete Pictorials Combined. Three (Participant Group: Undergraduates, Adults, Elders) x five (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials, Control) between-subjects ANOVA:

Source	df	SS	MS	F	p
Participant Group	2	481.43	240.72	50.88	.0000
Sheet Format	4	2198.22	549.55	116.16	.0000
Participant Group*Sheet Format	8	179.45	22.43	4.74	.0000
Error	201	950.96	4.73		

ANOVA Table 2

Free Recall: Directive vs. Explanation. Three (Participant Group:

Undergraduates, Adults, Elders) x five (Sheet Format: Text Alone, Pictorials Alone,

Text and Pictorials, Incomplete Pictorials, Control) x two (Question Composition:

Directive, Explanation) mixed model ANOVA:

Source	df	SS	MS	F	p
Participant Group	2	240.72	120.36	50.88	.0000
Sheet Format	4	1099.11	274.78	116.16	.0000
Participant Group*Sheet Format	8	89.73	11.22	4.74	.0000
Error	201	475.48	2.37		
Question Composition	1	564.06	564.06	435.82	.0000
Participant Group*Question Composition	2	1.26	0.63	0.49	.6144
Sheet Format*Question Composition	4	163.13	40.78	31.51	.0000
Participant Group*Sheet Format*Question Composition	8	34.79	4.35	3.36	.0012
Error	201	260.15	1.29		

ANOVA Table 3

Free Recall: Set. Three (Participant Group: Undergraduates, Adults, Elders) x six (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials 1, Incomplete Pictorials 2, Control) x two (Set: A, B) mixed model ANOVA:

Source	df	SS	MS	F	p
Participant Group	2	287.51	143.78	61.39	.0000
Sheet Format	5	1036.28	207.26	88.51	.0000
Participant Group*Sheet Format	10	89.46	8.95	3.82	.0001
Error	198	463.67	2.34		
Set	1	13.37	13.37	7.05	.0086
Participant Group*Set	2	0.23	0.11	0.60	.9420
Sheet Format*Set	5	20.94	4.19	2.21	0.55
Participant Group*Sheet Format*Set	10	30.80	3.08	1.62	.1021
Error	198	375.67	1.90		

ANOVA Table 4

Free Recall: Individual Instructions. Individual instructions repeated measures

ANOVA:

Source	df	SS	MS	F	p
Subjects	215	470.49	2.19		
Individual Instructions	7	43.22	6.18	15.91	.0000
Error	1505	584.28	60.39		

ANOVA Table 5

Free Recall: Incomplete Pictorials Omitted. Two (Text: Present, Absent) x two

(Pictorials: Present, Absent) between-subjects ANOVA:

Source	df	SS	MS	F	p
Text	1	1534.03	1534.03	229.65	.0000
Pictorials	1	245.44	245.44	36.74	.0000
Text*Pictorials	1	72.25	72.25	10.82	.0013
Error	140	935.17	6.68		

ANOVA Table 6

Cued Recall: Incomplete Pictorials Combined. Three (Participant Group: Undergraduates, Adults, Elders) x five (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials, Control) between- subjects ANOVA:

Source	df	SS	MS	F	p
Participant Group	2	152.98	76.49	15.22	.0000
Sheet Format	4	4331.80	1082.95	215.51	.0000
Participant Group*Sheet Format	8	25.11	3.14	0.63	.7566
Error	201	1010.04	5.03		

ANOVA Table 7

Cued Recall: Directive vs. Explanation. Three (Participant Group: Undergraduates, Adults, Elders) x five (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials, Control) x two (Question Composition: Directive, Explanation) mixed model ANOVA:

Source	df	SS	MS	F	p
Participant Group	2	75.84	37.92	15.11	.0000
Sheet Format	4	2167.56	541.89	215.92	.0000
Participant Group*Sheet Format	8	12.46	1.56	0.62	.7602
Error	201	504.46	2.51		
Question Composition	1	744.08	744.08	631.16	.0000
Participant Group*Question Composition	2	2.84	1.42	1.21	.3015
Sheet Format*Question Composition	4	195.04	48.76	41.36	.0000
Participant Group*Sheet Format*Question Composition	8	37.92	4.74	4.02	.0002
Error	201	236.96	1.18		

ANOVA Table 8

Cued Recall: Set. Three (Participant Group: Undergraduates, Adults, Elders) x six (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials 1, Incomplete Pictorials 2, Control) x two (Set: A, B) mixed model ANOVA:

Source	df	SS	MS	F	p
Participant Group	2	87.64	43.82	17.25	.0000
Sheet Format	5	2084.91	416.98	164.16	.0000
Participant Group*Sheet Format	10	12.21	1.22	0.48	.9014
Error	198	502.93	2.54		
Set	1	1.45	1.45	1.35	.2472
Participant Group*Set	2	7.46	3.73	3.48	.0328
Sheet Format*Set	5	9.43	1.89	1.76	.1235
Participant Group*Sheet Format*Set	10	14.71	1.47	1.37	.1963
Error	198	212.47	1.07		

ANOVA Table 9

Cued Recall: Individual Instructions. Individual instructions repeated measures

ANOVA:

Source	df	SS	MS	F	p
Subjects	215	671.92	3.13		
Individual Instructions	7	14.76	2.11	7.49	.0000
Error	1505	423.87	0.29		

ANOVA Table 10

Cued Recall: Incomplete Pictorials Omitted. Two (Text: Present, Absent) x two

(Pictorials: Present, Absent) between-subjects ANOVA:

Source	df	SS	MS	F	p
Text	1	3052.56	3052.56	674.81	.0000
Pictorials	1	269.51	269.51	59.58	.0000
Text*Pictorials	1	217.56	217.56	48.10	.0000
Error	140	633.31	4.52		

ANOVA Table 11

Ratings: Participant Group and Sheet Format. Three (Participant Group: Undergraduates, Adults, Elders) x six (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials 1, Incomplete Pictorials 2, Control) mixed model ANOVA:

Source	df	SS	MS	F	p
Participant Group	2	7.43	3.72	4.82	.0089
Error	213	164.10	0.77		
Sheet Format	5	1742.11	348.42	790.55	.0000
Participant Group*Sheet Format	10	22.35	2.24	5.07	.0000
Error	1065	469.38	0.44		

ANOVA Table 12

Ratings: First Exposure. Six (First Exposure: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials 1, Incomplete Pictorials 2, Control) x six (Sheet Format: Text Alone, Pictorials Alone, Text and Pictorials, Incomplete Pictorials 1, Incomplete Pictorials 2, Control) mixed model ANOVA:

Source	df	SS	MS	F	p
First Exposure	5	14.43	2.89	3.91	.0021
Error	210	155.23	0.74		
Sheet Format	5	1741.27	348.25	774.86	.0000
Participant Group*Sheet Format	25	17.99	0.72	1.60	.0312
Error	1050	471.91	0.45		

Appendix J

Free Recall Test Scores

<u>Participant Group</u>	<u>Sheet Format</u>	<u>Set A</u>	<u>Set B</u>	<u>Total</u>	<u>Directive</u>	<u>Explanation</u>
1-Undergrad	1-TO 4-IP1					
2-Adult	2-PO 5-IP2					
3-Elder	3-TP 6-C					
1	1	5	6	11	6	5
1	1	5	6	11	7	4
1	1	6	5	11	7	4
1	1	6	5	11	7	4
1	1	6	6	12	7	5
1	1	6	1	7	4	3
1	1	3	6	9	6	3
1	1	8	4	12	6	6
1	1	3	3	6	4	2
1	1	7	5	12	8	4
1	1	7	5	12	7	5
1	1	8	8	16	8	8
1	2	4	1	5	4	1
1	2	3	2	5	5	0
1	2	2	1	3	3	0
1	2	1	3	4	4	0
1	2	3	2	5	5	0
1	2	4	3	7	7	0
1	2	3	3	6	6	0
1	2	2	3	5	4	1
1	2	2	1	3	3	0
1	2	1	2	3	3	0
1	2	4	2	6	6	0
1	2	3	2	5	5	0
1	3	7	8	15	8	7
1	3	7	2	9	6	3
1	3	7	7	14	8	6
1	3	3	8	11	6	5
1	3	8	4	12	6	6
1	3	5	4	9	6	3
1	3	5	5	10	8	2
1	3	8	6	14	8	6
1	3	4	8	12	7	5
1	3	5	6	11	6	5
1	3	1	6	7	4	3
1	3	3	6	9	6	3
1	4	8	4	12	6	6
1	4	6	7	13	7	6
1	4	4	5	9	6	3
1	4	6	3	9	6	3
1	4	7	2	9	6	3
1	4	4	5	9	6	3
1	4	4	3	7	6	1
1	4	4	2	6	5	1
1	4	4	3	7	6	1
1	4	4	7	11	7	4
1	4	6	6	12	8	4
1	4	7	3	10	6	4
1	5	7	6	13	8	5
1	5	5	5	10	7	3
1	5	5	4	9	5	4
1	5	3	7	10	6	4
1	5	5	4	9	5	4
1	5	4	4	8	5	3
1	5	4	5	9	7	2

Participant Group	Sheet Format	Set A	Set B	Total	Directive	Explanation
1	5	3	0	3	3	0
1	5	2	5	7	4	3
1	5	5	3	8	6	2
1	5	8	6	14	7	7
1	5	6	6	12	6	6
1	6	0	0	0	0	0
1	6	0	0	0	0	0
1	6	0	0	0	0	0
1	6	0	0	0	0	0
1	6	0	0	0	0	0
1	6	0	0	0	0	0
1	6	0	0	0	0	0
1	6	0	0	0	0	0
1	6	0	0	0	0	0
1	6	0	0	0	0	0
1	6	0	0	0	0	0
2	1	6	6	12	6	6
2	1	6	0	6	3	3
2	1	6	4	10	5	5
2	1	4	4	8	6	2
2	1	6	4	10	7	3
2	1	4	2	6	4	2
2	1	3	6	9	5	4
2	1	5	2	7	5	2
2	1	3	6	9	5	4
2	1	5	4	9	7	2
2	1	6	5	11	7	4
2	1	6	1	7	6	1
2	2	3	2	5	5	0
2	2	4	1	5	5	0
2	2	3	3	6	6	0
2	2	3	3	6	6	0
2	2	2	1	3	3	0
2	2	4	3	7	6	1
2	2	4	3	7	7	0
2	2	4	4	8	8	0
2	2	0	1	1	1	0
2	2	4	1	5	5	0
2	2	2	0	2	2	0
2	2	2	2	4	4	0
2	3	6	8	14	8	6
2	3	3	4	7	5	2
2	3	4	3	7	7	0
2	3	3	6	9	5	4
2	3	6	5	11	7	4
2	3	6	4	10	5	5
2	3	4	4	8	8	0
2	3	5	6	11	6	5
2	3	7	6	13	7	6
2	3	7	2	9	5	4
2	3	8	2	10	5	5
2	3	3	6	9	6	3
2	4	4	5	9	6	3
2	4	2	4	6	6	0
2	4	3	2	5	4	1
2	4	4	5	9	6	3
2	4	3	5	8	5	3
2	4	3	0	3	3	0
2	4	2	2	4	4	0
2	4	5	4	9	6	3
2	4	6	3	9	6	3
2	4	5	4	9	6	3
2	4	6	2	8	5	3

<u>Participant Group</u>	<u>Sheet Format</u>	<u>Set A</u>	<u>Set B</u>	<u>Total</u>	<u>Directive</u>	<u>Explanation</u>
2	4	5	4	9	6	3
2	5	1	3	4	3	1
2	5	5	6	11	6	5
2	5	2	1	3	3	0
2	5	3	5	8	5	3
2	5	2	7	9	6	3
2	5	3	8	11	6	5
2	5	4	4	8	6	2
2	5	5	2	7	5	2
2	5	5	8	13	7	6
2	5	6	6	12	6	6
2	5	5	5	10	7	3
2	5	3	8	11	6	5
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
3	1	4	2	6	6	0
3	1	4	1	5	4	1
3	1	3	3	6	4	2
3	1	3	0	3	3	0
3	1	3	0	3	2	1
3	1	1	1	2	2	0
3	1	2	1	3	3	0
3	1	2	1	3	3	0
3	1	3	4	7	7	0
3	1	5	4	9	6	3
3	1	2	2	4	4	0
3	1	1	0	1	1	0
3	2	1	0	1	1	0
3	2	2	3	5	5	0
3	2	3	3	6	6	0
3	2	2	2	4	4	0
3	2	0	0	0	0	0
3	2	3	2	5	5	0
3	2	0	0	0	0	0
3	2	1	1	2	2	0
3	2	0	0	0	0	0
3	2	0	1	1	1	0
3	2	2	3	5	5	0
3	2	0	0	0	0	0
3	3	6	5	11	7	4
3	3	4	3	7	6	1
3	3	3	2	5	5	0
3	3	2	4	6	3	3
3	3	3	2	5	5	0
3	3	4	6	10	6	4
3	3	4	2	6	6	0
3	3	3	4	7	7	0
3	3	7	2	9	6	3
3	3	1	3	4	3	1
3	3	2	0	2	2	0
3	3	5	1	6	5	1
3	4	0	0	0	0	0
3	4	3	1	4	4	0
3	4	0	1	1	1	0

<u>Participant Group</u>	<u>Sheet Format</u>	<u>Set A</u>	<u>Set B</u>	<u>Total</u>	<u>Directive</u>	<u>Explanation</u>
3	4	2	4	6	5	1
3	4	2	3	5	4	1
3	4	1	2	3	3	0
3	4	3	4	7	5	2
3	4	2	0	2	2	0
3	4	1	1	2	2	0
3	4	4	1	5	5	0
3	4	1	3	4	4	0
3	4	5	5	10	7	3
3	5	2	1	3	3	0
3	5	3	1	4	3	1
3	5	2	1	3	3	0
3	5	2	2	4	2	2
3	5	3	3	6	5	1
3	5	1	1	2	2	0
3	5	5	2	7	5	2
3	5	3	5	8	6	2
3	5	5	2	7	5	2
3	5	1	2	3	3	0
3	5	3	4	7	6	1
3	5	4	3	7	7	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0

<u>Q1</u>	<u>Q3</u>	<u>Q4</u>	<u>Q7</u>	<u>Q2</u>	<u>Q5</u>	<u>Q6</u>	<u>Q8</u>
2	0	1	2	0	2	2	2
1	1	1	2	0	2	2	2
1	1	2	2	0	2	1	2
1	1	2	2	1	0	2	2
1	2	1	2	0	2	2	2
2	2	2	0	0	0	0	1
1	0	2	0	1	1	2	2
2	2	2	2	2	0	0	2
0	1	2	0	0	0	1	2
1	2	2	2	1	1	1	2
1	2	2	2	1	0	2	2
2	2	2	2	2	2	2	2
1	1	2	0	0	0	0	1
1	1	0	1	1	0	0	1
1	0	1	0	0	0	0	1
0	1	0	0	1	1	0	1
1	0	1	1	0	1	1	1
1	1	1	1	0	0	1	1
1	1	1	0	1	0	1	1
1	0	0	1	0	2	0	1
0	1	1	0	0	0	0	1
0	1	0	0	0	1	0	1
1	1	1	1	0	1	0	1
1	1	0	1	0	1	0	1
1	1	2	2	2	2	2	2
1	2	2	2	1	1	0	0
1	2	2	2	2	2	2	1
1	0	0	2	2	2	2	2
2	2	2	2	0	2	0	2
2	0	2	1	1	1	2	0
1	1	2	1	1	2	1	1
2	2	2	2	1	2	2	1
1	2	1	0	2	2	2	2
2	1	2	0	0	2	2	2
1	0	0	0	2	0	2	2
1	0	0	2	2	1	1	2
2	2	2	2	0	0	2	2
2	0	2	2	1	2	2	2
1	1	2	0	1	0	2	2
1	1	2	2	0	1	0	2
2	2	1	2	1	0	0	1
1	0	2	1	0	1	2	2
1	0	1	2	0	1	0	2
1	0	2	1	1	0	1	0
0	1	1	1	0	1	0	2
1	1	2	1	1	2	2	2
1	2	2	1	1	2	1	2
2	2	1	2	0	0	2	1
2	2	2	2	1	1	2	2
0	1	2	2	1	1	1	2
1	2	0	2	2	0	0	2
1	0	0	2	2	2	2	1
1	0	2	2	0	2	2	0
1	0	2	1	0	0	2	2
1	1	2	0	2	1	1	1
0	1	0	2	0	0	0	0
0	0	2	0	1	0	2	2
1	0	2	2	1	1	0	1
2	2	2	2	2	0	2	2
2	2	0	2	0	2	2	2
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

<u>Q1</u>	<u>Q3</u>	<u>Q4</u>	<u>Q7</u>	<u>Q2</u>	<u>Q5</u>	<u>Q6</u>	<u>Q8</u>
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	2	2	2	2	2	0	2
2	2	2	0	0	2	2	0
2	0	2	1	0	1	1	2
1	1	2	2	1	2	1	0
1	0	2	1	0	0	0	2
1	0	2	0	0	2	2	2
1	1	1	2	0	0	0	2
2	0	0	1	0	2	2	2
1	1	2	1	1	0	1	2
1	1	2	2	0	2	2	1
1	1	2	2	0	0	0	1
1	1	0	1	0	1	1	0
1	1	1	1	0	0	0	1
1	0	1	1	1	1	1	0
1	1	0	1	0	1	1	1
0	1	0	1	0	0	0	1
0	1	1	2	1	0	1	1
1	1	1	1	0	1	1	1
1	1	1	1	1	1	1	1
0	0	0	0	1	0	0	0
1	1	1	1	0	0	1	0
1	1	0	0	0	0	0	0
1	1	0	0	1	0	0	1
1	2	2	1	2	2	2	2
1	0	2	0	1	0	1	1
1	1	1	1	0	1	1	1
0	0	0	0	1	0	0	0
1	1	1	1	0	0	1	0
1	1	0	0	0	0	0	0
1	1	0	0	1	0	0	1
1	2	0	1	2	1	0	2
1	0	2	0	1	2	2	0
1	0	1	1	0	0	0	0
1	0	0	1	1	1	0	0
1	0	2	2	0	1	2	1
2	1	1	1	1	0	0	2
2	0	2	2	1	1	0	2
1	2	1	2	0	0	0	2
1	1	2	1	2	0	0	2
1	0	0	0	2	0	1	0
1	0	2	2	0	2	2	2
0	0	1	1	0	0	0	1
0	1	2	0	2	1	2	0
1	0	0	1	1	2	2	2
2	0	1	2	0	1	2	1
1	0	1	2	0	0	0	2

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<u>Q1</u>	<u>Q3</u>	<u>Q4</u>	<u>Q7</u>	<u>Q2</u>	<u>Q5</u>	<u>Q6</u>	<u>Q8</u>
1	1	0	0	1	0	0	0
2	0	1	0	0	1	0	0
1	0	0	1	0	0	0	1
0	0	2	0	2	0	0	0
0	0	2	1	1	1	0	1
0	0	1	0	0	0	0	1
1	1	1	2	0	0	0	2
0	1	1	1	0	1	2	2
1	1	2	1	0	0	0	2
0	0	1	0	0	0	1	1
1	1	0	1	0	1	1	2
1	1	1	1	0	1	1	1
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Appendix K

Cued Recall Test Scores

<u>Participant Group</u>	<u>Sheet Format</u>	<u>Set A</u>	<u>Set B</u>	<u>Total</u>	<u>Directive</u>	<u>Explanation</u>
1-Undergrad	1-TO 4-IP1					
2-Adult	2-PO 5-IP2					
3-Elder	3-TP 6-C					
1	1	5	6	11	8	3
1	1	6	6	12	7	5
1	1	7	6	13	8	5
1	1	8	8	16	8	8
1	1	6	7	13	8	5
1	1	7	5	12	8	4
1	1	8	7	15	8	7
1	1	8	8	16	8	8
1	1	7	4	11	6	5
1	1	6	6	12	8	4
1	1	8	6	14	8	6
1	1	8	8	16	8	8
1	2	5	2	7	5	2
1	2	4	5	9	8	1
1	2	3	1	4	4	0
1	2	3	3	6	6	0
1	2	5	2	7	6	1
1	2	4	3	7	7	0
1	2	3	3	6	5	1
1	2	5	3	8	6	2
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1	2	3	3	6	6	0
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1	3	8	7	15	8	7
1	3	5	8	13	7	6
1	3	8	7	15	8	7
1	3	8	6	14	8	6
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1	3	7	7	14	8	6
1	3	8	8	16	8	8
1	3	6	7	13	8	5
1	3	4	7	11	7	4
1	3	3	6	9	6	3
1	4	8	5	13	7	6
1	4	6	8	14	7	7
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1	4	7	6	13	8	5
1	4	7	5	12	8	4
1	4	7	6	13	8	5
1	4	8	7	15	8	7
1	4	7	5	12	8	4
1	4	4	3	7	4	3
1	4	7	7	14	8	6
1	4	8	6	14	8	6
1	4	7	4	11	7	4
1	5	7	8	15	8	7
1	5	6	6	12	8	4
1	5	6	6	12	7	5
1	5	7	8	15	8	7
1	5	8	7	15	8	7
1	5	6	6	12	8	4

<u>Participant Group</u>	<u>Sheet Format</u>	<u>Set A</u>	<u>Set B</u>	<u>Total</u>	<u>Directive</u>	<u>Explanation</u>
1	5	7	5	12	8	4
1	5	3	4	7	5	2
1	5	5	5	10	6	4
1	5	7	6	13	8	5
1	5	8	8	16	8	8
1	5	5	7	12	7	5
1	6	0	0	0	0	0
1	6	0	0	0	0	0
1	6	1	0	1	1	0
1	6	0	0	0	0	0
1	6	2	1	3	3	0
1	6	1	0	1	1	0
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1	6	0	0	0	0	0
1	6	1	1	2	2	0
1	6	3	3	6	5	1
1	6	0	1	1	1	0
2	1	7	7	14	8	6
2	1	5	3	8	6	2
2	1	6	5	11	6	5
2	1	6	7	13	8	5
2	1	6	6	12	8	4
2	1	8	6	14	8	6
2	1	8	8	16	8	8
2	1	7	6	13	8	5
2	1	6	6	12	7	5
2	1	6	5	11	8	3
2	1	7	6	13	8	5
2	1	6	6	12	8	4
2	2	3	3	6	6	0
2	2	4	3	7	7	0
2	2	4	4	8	8	0
2	2	3	4	7	7	0
2	2	4	3	7	7	0
2	2	3	4	7	7	0
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2	2	4	4	8	8	0
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2	2	3	0	3	3	0
2	2	2	3	5	5	0
2	2	5	3	8	6	2
2	3	7	7	14	8	6
2	3	4	5	9	7	2
2	3	7	5	12	8	4
2	3	4	7	11	7	4
2	3	7	7	14	8	6
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2	4	4	4	8	6	2
2	4	4	7	11	7	4
2	4	3	5	8	6	2
2	4	6	5	11	7	4
2	4	4	5	9	7	2
2	4	7	7	14	8	6
2	4	7	5	12	7	5
2	4	6	7	13	8	5

<u>Participant Group</u>	<u>Sheet Format</u>	<u>Set A</u>	<u>Set B</u>	<u>Total</u>	<u>Directive</u>	<u>Explanation</u>
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2	5	6	7	13	8	5
2	5	6	5	11	8	3
2	5	6	6	12	8	4
2	5	2	3	5	5	0
2	5	4	8	12	6	6
2	5	6	5	11	8	3
2	5	7	7	14	8	6
2	5	8	8	16	8	8
2	5	5	8	13	8	5
2	5	8	8	16	8	8
2	5	5	8	13	7	6
2	6	2	1	3	3	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
2	6	0	0	0	0	0
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3	1	6	4	10	7	3
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3	1	3	4	7	4	3
3	1	7	4	11	7	4
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3	1	5	7	12	8	4
3	1	8	6	14	8	6
3	1	5	3	8	7	1
3	1	3	4	7	7	0
3	2	1	1	2	2	0
3	2	3	3	6	6	0
3	2	4	4	8	8	0
3	2	2	3	5	5	0
3	2	0	1	1	1	0
3	2	4	2	6	5	1
3	2	0	1	1	1	0
3	2	2	2	4	4	0
3	2	2	3	5	4	1
3	2	2	2	4	4	0
3	2	3	3	6	5	1
3	2	0	1	1	1	0
3	3	7	7	14	8	6
3	3	6	7	13	7	6
3	3	6	5	11	7	4
3	3	5	6	11	7	4
3	3	5	3	8	7	1
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3	3	8	6	14	8	6
3	3	3	4	7	6	1
3	3	7	1	8	5	3
3	3	8	7	15	8	7
3	4	3	3	6	5	1
3	4	7	7	14	8	6

<u>Participant Group</u>	<u>Sheet Format</u>	<u>Set A</u>	<u>Set B</u>	<u>Total</u>	<u>Directive</u>	<u>Explanation</u>
3	4	4	1	5	4	1
3	4	6	5	11	7	4
3	4	3	7	10	6	4
3	4	4	2	6	6	0
3	4	4	8	12	7	5
3	4	3	4	7	6	1
3	4	5	4	9	7	3
3	4	8	6	14	8	6
3	4	4	4	8	7	1
3	4	8	7	15	8	7
3	5	2	3	5	5	0
3	5	6	5	11	8	3
3	5	4	4	8	6	2
3	5	3	4	7	6	1
3	5	6	5	11	8	3
3	5	4	6	10	7	3
3	5	7	6	13	7	6
3	5	3	7	10	6	4
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3	5	5	6	11	8	3
3	5	7	6	13	8	5
3	5	7	6	13	8	5
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
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3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0
3	6	2	0	2	2	0
3	6	0	0	0	0	0
3	6	0	0	0	0	0

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<u>Q1</u>	<u>Q3</u>	<u>Q4</u>	<u>Q7</u>	<u>Q2</u>	<u>Q5</u>	<u>Q6</u>	<u>Q8</u>
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0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	1	0	1	0	0
0	2	0	1	0	1	1	1
0	0	0	0	0	0	0	1
1	2	2	2	1	2	2	2
2	0	2	1	1	1	0	1
2	2	0	2	1	2	2	0
1	2	2	1	2	2	1	2
1	1	2	2	1	2	2	1
2	2	2	2	1	2	2	1
2	2	2	2	2	2	2	2
2	1	2	2	2	1	2	1
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1	1	2	2	1	1	1	2
1	2	2	2	1	2	2	1
1	1	2	2	1	2	2	1
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1	0	0	1	1	0	1	1
2	2	0	1	1	0	1	1
2	1	2	2	2	1	2	2
1	0	2	1	1	1	2	1
2	2	2	1	1	2	1	1
1	1	0	2	2	1	2	2
1	2	2	2	2	1	2	2
2	2	2	2	2	2	2	2
1	2	2	1	1	1	2	1
1	0	2	1	2	2	2	2
2	2	1	2	1	1	2	2
1	2	2	2	2	2	2	2
2	2	2	2	1	2	2	2
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1	2	0	1	2	1	2	2
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2	1	2	1	1	2	2	0
1	0	1	2	1	2	1	1
2	1	2	2	2	2	2	1
2	2	2	1	1	0	2	2
1	1	2	2	1	2	2	2
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2	1	2	1	1	1	2	1
2	1	2	2	2	1	2	2
2	2	2	2	2	2	2	2
1	1	2	1	2	2	2	2
2	2	2	2	2	2	2	2

<u>Q1</u>	<u>Q3</u>	<u>Q4</u>	<u>Q7</u>	<u>Q2</u>	<u>Q5</u>	<u>Q6</u>	<u>Q8</u>
0	1	2	2	2	2	2	2
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2	1	2	2	0	1	1	2
1	1	1	1	2	1	2	1
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1	1	2	1	0	1	1	1
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2	0	0	0	0	1	1	1
1	0	0	1	1	0	0	1
2	0	1	0	1	0	1	1
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2	0	2	2	1	1	2	1
0	2	2	1	1	1	2	2
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1	0	1	1	1	2	2	2
2	1	2	2	1	1	2	2
2	2	2	1	1	2	2	1
2	2	2	2	1	1	2	2
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2	2	2	1	0	0	0	1
2	2	2	2	1	2	2	2
0	0	2	1	1	0	1	1
2	1	2	2	2	1	2	2
2	0	1	1	0	0	0	1
0	2	0	2	1	2	2	2
1	1	1	1	0	1	0	1
0	1	2	1	2	2	2	2
1	0	1	1	0	1	2	1
2	2	0	1	1	1	1	1
2	2	2	2	2	1	2	1
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1	1	0	2	1	1	1	1
2	2	2	2	1	1	2	2
1	1	0	0	1	1	1	0
2	1	2	1	1	1	2	1
1	1	0	2	1	0	2	1

<u>Q1</u>	<u>Q3</u>	<u>Q4</u>	<u>Q7</u>	<u>Q2</u>	<u>Q5</u>	<u>Q6</u>	<u>Q8</u>
2	0	1	0	1	1	1	1
2	1	2	1	1	1	1	2
0	1	1	2	1	2	2	1
2	1	2	2	2	0	2	2
0	0	2	1	1	2	2	2
2	1	2	1	2	1	1	2
1	1	2	1	1	2	2	1
1	2	2	2	2	1	1	2
1	2	2	2	1	2	2	1
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
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0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	2	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Appendix L

Raw Data - Ratings

Participant Group	First Exposure	TO	PO	TP	IP1	IP2	C
1-Undergrad	1-TO 4-IP1						
2-Adult	2-PO 5-IP2						
3-Elder	3-TP 6-C						
1	1	5	2	5	3	3	1
1	1	3	2	5	3	3	1
1	1	4	2	5	3	3	1
1	1	3	2	5	4	4	1
1	1	3	2	5	4	4	1
1	1	3	1	5	4	4	1
1	1	3	2	5	3	3	1
1	1	2	2	5	3	3	1
1	1	3	2	4	5	3	1
1	1	2	1	5	4	4	1
1	1	3	2	5	4	4	1
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1	2	4	3	5	4	3	1
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1	2	3	2	5	4	4	1
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1	2	3	2	5	4	4	1
1	2	3	2	5	4	4	1
1	2	3	2	5	3	3	1
1	2	3	3	5	3	3	1
1	3	5	2	5	4	4	1
1	3	3	2	5	4	4	1
1	3	3	2	5	4	4	1
1	3	3	2	5	4	4	1
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1	5	3	3	5	2	4	1
1	5	2	1	5	3	3	1
1	5	3	2	5	4	4	2
1	5	3	2	5	4	4	1
1	5	3	2	5	4	4	1

Participant Group	First Exposure	TO	PO	TP	IP1	IP2	C
1	5	3	2	5	4	4	1
1	5	1	1	5	3	2	1
1	5	3	1	5	3	3	1
1	5	3	2	5	4	4	1
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1	6	3	2	5	4	4	1
1	6	4	1	3	5	2	1
1	6	3	3	5	3	3	1
1	6	3	3	5	4	4	1
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2	1	4	2	5	4	4	1
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2	1	4	1	5	4	4	1
2	2	3	3	4	3	3	2
2	2	3	4	5	3	3	1
2	2	4	3	5	4	4	1
2	2	2	3	5	2	2	1
2	2	2	4	5	3	2	1
2	2	3	3	5	4	4	1
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2	4	2	1	5	3	3	1
2	4	2	2	5	4	4	1
2	4	2	3	5	3	3	1
2	4	3	2	4	3	3	2

Participant Group	First Exposure	TO	PO	TP	IP1	IP2	C
2	4	3	1	5	4	3	1
2	5	2	1	5	3	3	1
2	5	3	2	5	4	4	1
2	5	2	1	4	2	2	1
2	5	3	2	5	2	3	1
2	5	3	3	5	2	4	1
2	5	4	4	5	2	3	1
2	5	4	2	5	2	2	1
2	5	3	1	5	2	2	1
2	5	2	1	4	3	3	1
2	5	3	2	5	2	2	1
2	5	2	4	5	3	3	1
2	5	2	2	5	3	3	1
2	6	2	2	5	3	3	1
2	6	4	3	5	2	2	1
2	6	2	2	5	2	2	1
2	6	1	1	3	1	3	1
2	6	3	2	5	2	2	1
2	6	2	1	5	3	3	1
2	6	3	2	5	2	2	1
2	6	3	2	5	3	3	1
2	6	3	2	5	4	4	1
2	6	3	2	5	3	3	1
2	6	3	2	3	4	4	1
2	6	2	2	4	3	3	1
3	1	4	1	4	2	2	1
3	1	3	2	5	4	4	1
3	1	3	2	5	3	3	1
3	1	3	2	5	3	3	1
3	1	3	2	5	3	3	1
3	1	3	1	5	4	4	1
3	1	4	2	5	3	3	1
3	1	4	1	5	2	2	1
3	1	4	1	5	2	2	1
3	1	4	2	4	4	4	1
3	1	3	1	5	4	4	1
3	1	4	2	5	3	3	1
3	2	2	1	5	4	2	1
3	2	4	2	4	4	4	1
3	2	5	5	5	5	5	1
3	2	5	1	3	2	2	1
3	2	4	1	5	3	3	1
3	2	3	2	5	4	4	1
3	2	3	2	5	4	4	1
3	2	5	2	4	3	3	1
3	2	3	2	5	3	3	1
3	2	4	2	5	2	3	1
3	2	4	1	5	3	4	1
3	2	2	1	5	2	3	1
3	3	3	1	5	4	4	1
3	3	2	2	5	3	3	1
3	3	4	1	5	3	3	1
3	3	3	2	4	3	3	1
3	3	2	2	5	4	3	1
3	3	1	1	4	2	2	1
3	3	4	2	4	3	3	1
3	3	4	2	5	2	2	1
3	3	3	1	5	3	3	1
3	3	3	1	5	2	2	1
3	3	2	1	5	3	2	1
3	3	3	2	5	3	3	1
3	4	2	2	5	4	4	1
3	4	2	1	5	4	4	1
3	4	1	1	5	4	4	1
3	4	1	1	5	5	5	1

<u>Participant Group</u>	<u>First Exposure</u>	<u>TO</u>	<u>PO</u>	<u>TP</u>	<u>IP1</u>	<u>IP2</u>	<u>C</u>
3	4	3	1	4	2	3	1
3	4	3	1	5	3	4	1
3	4	2	1	5	4	3	1
3	4	4	3	5	5	4	1
3	4	5	1	5	3	3	1
3	4	4	2	4	3	4	1
3	4	3	2	5	4	3	1
3	4	5	1	4	3	3	1
3	4	3	3	5	4	4	1
3	5	5	3	5	2	4	1
3	5	5	1	2	3	3	1
3	5	3	3	3	3	3	1
3	5	2	1	5	4	4	1
3	5	2	2	4	2	2	1
3	5	4	2	5	3	4	1
3	5	2	2	5	3	3	1
3	5	4	1	5	4	4	1
3	5	4	2	4	3	4	1
3	5	3	1	5	4	3	1
3	5	5	2	4	4	4	4
3	5	2	2	5	2	2	1
3	6	3	2	5	3	3	1
3	6	2	1	5	3	3	1
3	6	4	1	2	2	3	1
3	6	3	1	5	2	3	1
3	6	5	1	3	4	3	1
3	6	5	1	4	3	3	1
3	6	3	1	5	2	4	1
3	6	3	1	5	2	2	1
3	6	3	2	5	5	3	2
3	6	4	2	5	4	5	1
3	6	3	1	2	4	3	1
3	6	3	2	5	3	3	1